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SURVEY OF SUMATRAN PRIMATES: DIVERSITY AND ABUNDANCE IN A SHRINKING PARADISE

by Carolyn Crockett and Wendell L. Wilson

Following is a summary of the authors' survey results. The major publication from their research is still in preparation.

Our survey was funded by a grant from the U.S. Public Health Service, National Institutes of Health, to the Regional Primate Research Center (RPRC) at the University of Washington. The Primate Center began importing pigtail macaques *(Macaca nemestrina)* from Indonesia in 1970 for use as breeding stock in the Center's Primate Field Station in Eastern Washington State (Smith, 1975). The distribution and abundance of this species and the longtail macaque *(M. fascicularis)* in Sumatra were unknown. In the interests of a continued supply of laboratory animals for biomedical research without endangering the source population, the RPRC sent us to Sumatra to conduct a survey. We were not interested exclusively in primates for biomedical research. We wished to determine the distribution, relative abundance, and habitat preference of all the diurnal primates of Sumatra. Between November 1971 and January 1973 we surveyed 634 km^2 (32 km^2 on foot, 79 km^2 by boat, and 543 km^2 by jeep), sampling the length and breadth of Sumatra and covering about 0.2% of its total area. We distinguished 25 different habitat types below 1500 m based on elevation, degree of disturbance, swampiness, proximity to rivers, and predominant flora. Data were collected using a transect or strip-census technique. For each primate group contacted we noted the following information: species, number and composition in the group (plus some indication of confidence in these figures), time of contact, habitat type, distance from cultivated areas, type of tree occupied (if known), behavior, height in tree at first contact, direction of travel after contact, terrain and elevation. We calculated estimated individual density by dividing groups encountered by area surveyed and multiplying by mean troop size (based on complete counts rather than mean group size of all encounters).

Macaques

Macaca fascicularis, the longtailed macaque and *M. nemestrina,* the pigtailed macaque are broadly sympatric throughout Sumatra. The longtailed macaque is the most abundant primate in Sumatra, and was observed in 22 of the 25 habitat types surveyed. This macaque prefers riparian and disturbed habitats, and dense populations occur along rivers, especially in mangrove and freshwater swamps. Troops living adjacent to farmland regularly raid crops. Longtailed macaques live in multimale troops with a mean size of 18.6; size varies with habitat, and larger troops of over 40 individuals are found in secondary forests.

The pigtailed macaque although widely distributed throughout Sumatra, is rare in swampy areas and was encountered in only eight of the 25 habitat types. Highest densities occurred in primary lowland and hill forests. Like *M. fascicularis,* pigtails live in multimale troops, and solitary males are commonly observed; mean troops size is 18.3. Troops range over large areas, often raiding farms in a circuit. *Macaca nemestrina* appear to have far less restricted home ranges than do *M. fascicularis;* a pigtailed macaque troop may abandon part of its home range for months after a food crop is depleted. *Macaca nemestrina* is the most terrestrial Sumatran primate, although M. fascicularis frequently descends to the ground.

Langurs

The silvered langur, *Presbytis cristata,* is widely distributed in coastal and riverine habitats, and is the second most abundant species of primate in Sumatra. Like *M. fascicularis,* members of this species prefer disturbed and riparian habitats, and are rarely found deep within primary forests or at higher elevations. *Presbytis cristata* were encountered in 20 habitat types, the highest population densities occurring in mixed mangrove riverbank areas. The silvered langur lives in unimale to age-graded troops (Eisenberg, Muckenhirn and Rudran's classificatory system, 1972). Bernstein's (1968) data on groups composition (Kuala Selangor, West Malaysia) indicate only one fully adult male per troop. We observed an average of 10.6 individuals per troop (maximum = 22), compared with Bernstein's (1968) observation of 32 per troop.

The remaining Sumatran representatives of the genus *Presbytis* have been classified into species and subspecies of the *P. aygula-melalophos* group (banded langurs), which is also distributed throughout other areas of Southeast Asia (Medway, 1970). All species of banded langurs show behavioral similarities, further validating their classification into one subgeneric group, and all are behaviorally discernible from the sympatric *P. cristata*. In contrast to the blackish *P. cristata*, pelage color of members of the *P. aygula–melalophos* group varies greatly with geographic location; taxonomists have assigned subspecific names to most of the allopatric or parapatric populations, basing their assignments on hair patterns and pelage colors (Crockett Wilson and Wilson, 1976). Most of the Sumatran subspecies have been considered members of the species *P. melalophos*, with some speculation that *P. thomasi* might be a separate species (Medway, 1970).

It became obvious to us after observing this diverse group of monkeys that some taxonomic revision is in order. Our survey began in southern Sumatra and, as we proceeded northward, we encountered many different colors of banded langur, each restricted to a particular geographic location. However, in terms of behavior and habitat preference they were indistinguishable. Most notably, the loud calls of the adult males were qualitatively identical. When we surveyed in Riau Province, eastern-central Sumatra, we were surprised to hear that the loud call was qualitatively different from what we had heard to the south and west. Again, in the northernmost province of Aceh, another qualitatively different vocalization was encountered. Since there is reason to believe that such calls serve as ethological reproductive isolating mechanisms, we have assigned specific status to various populations on the basis of differences in the adult male loud call (Wilson and Wilson, 1975).

Banded langur troops are generally smaller than silvered langur troops; unimale troops of five to eight individuals in primary forests and ten to 13 individuals in secondary forests are typical. The larger troops may be agegraded in composition (i.e., including maturing males not yet excluded by the dominant male), but this was not verified in our survey.

Presbytis melalophos the most widely distributed species of the *P. aygula-melalophos* group in Sumatra, occurs from the southern tip of the island to north of Lake Toba; it does not occur north of two large rivers, the Simpangkiri in the west and Wampu in the east.

These monkeys prefer inland forests, and are abundant in primary lowland and hill forests. They are rarely encountered in swampy areas or along riverbanks; although they are commonly observed in inland secondary forests, they are generally less dense there than in primary forests. *Presbytis melalophos* was observed in 15 habitat types.

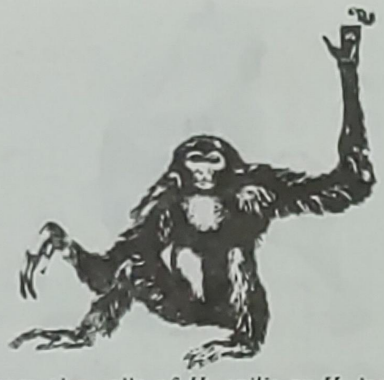
Presbytis femoralis occurs in the swampy and dry lowland forests of Riau Province. It was encountered in only ten habitat types, but these included most of the types available within its distribution. Unlike *P. melalophos, P. femoralis* was commonly seen along riverbanks with *P. cristata*, but unlike *P. cristata, P. femoralis* was abundant in inland forests. Recently, Borner (1974) reported an inland area of possible overlap between *P. melalophos* and *P. femoralis* near the Barumun River, but we were unable to determine the boundary or presence of overlap between these two species near the border between West Sumatra and Riau Province. *Presbytis melalophos* is the species name commonly used to refer to banded langurs in West Malaysia (Medway, 1970; Chivers, 1973), but we believe that they may be most closely related to *P. femoralis*.

A third species of this group, *P. thomasi*, is found in Aceh Province, north of the Simpangkiri and Wampu rivers. *Presbytis thomasi* seems to be very similar to *P. melalophos* in group size, behavior, density, and habitat preference, inhabiting inland primary and secondary forests. Swampy habitats and large rivers are rare within its primarily mountainous distribution.

Apes

The gibbons and the siamang are monogamous, with troop sizes of two to six individuals, and are territorial, using morning vocalizations as a spacing mechanism. The gibbons define their territories with calls and physical displays at the boundaries, while siamang groups announce their location by calls from the center of the territory. Siamang males also show paternal care behaviour not observed in gibbons. Our observations are very compatible with more detailed studies of these species in Malaysia.

The siamang, *Symphalangus syndactylus* is considerably larger than the gibbons, and produces a vocalization with its throat sac that is entirely dif-



ferent from the calls of *H. agilis* or *H. lar*. Siamangs occur in and near the Barisan mountain chain, which runs the length of western Sumatra. Within their distribution, siamangs are sympatric with *H. agilis* or *H. lar*, and are usually more abundant than sympatric gibbons at higher elevations. The siamang prefers primary lowland and hill forest habitats.

Hylobates agilis, the dark-handed gibbon, is the most widely distributed and abundant of the gibbons in Sumatra. Its range includes the southern three–quarters of the island, and is probably bounded to the north by the Simpangkiri and Wampu rivers. It is most abundant in the primary freshwater swamps of east Sumatra, and also occurs in primary lowland, hill, and submontane forests.

Hylobates lar the white-handed gibbon, is restricted to the area north of the Simpangkiri and Wampu rivers, as are *Presbytis thomasi* and the orang-utan *(Pongo pygmaeus)*. *Hylobates lar* is readily distinguished from *H. agilis* by its white hands and feet and by the qualitatively different calls of both males and females. In its behaviour, social structure, territoriality, and population density, the white handed gibbon closely resembles *H. agilis*. Extensive primary freshwater swamp is absent from its distribution area, but *H. lar* was quite abundant in primary lowland forest that had been selectively logged. The siamang occurs throughout the range of *H. lar* in Sumatra, but no area of sympatry between *H. lar* and *H. agilis* has yet been found there.

We only observed the orang utan on a few occasions.

Considerations for the Future

How many primates remain in Sumatra? Extrapolations from density data are possible but must be considered *highly tentative*. Figures specifying km^2 of forest remaining (Direktorat Jendral Kehutanan, 1970) suggest that nearly half of the 472,830 km^2 of Sumatra was still forested at the time the information was collected. However, selectively logged forests and other disturbed forests are probably included in the figures, and the rate of selective logging and forest felling for agricultural purposes is on the increase.

Primates still are common in primary forests and secondary growth where at least scattered clumps of trees survive. During our survey on foot and by boat, we observed approximately 6 groups and 27 individuals per km^2 for all species combined; the latter figure is an underestimate because complete groups are rarely seen. Roadside habitats typically are disturbed, and extensive uninhabited savannas of alang-alang grass *(Imperata cylindrica)* are found in some areas of Sumatra. This is reflected in the much lower roadside primate densities we observed, approximately 0.3 groups and 2.4 individuals per km^2 of these habitats.

The silvered langur and the longtailed macaque are the most abundant primates in Sumatra; 85% of individuals observed during our survey were of these two species. The total population sizes in Sumatra approximate at least several million for each species. These species' preference for disturbed habitats suggests that they will be least affected by an increasing human population. In fact, both the silvered langur and the longtailed macaque show evidence of dispersal into inland, higher elevation habitats which have been altered from primary to secondary by human activities. Both species are commonly observed in proximity to "kampungs" (villages).

The next most abundant primates are the banded langurs *(P. melalophos, P. femorlis,* and *P. thomasi)*. They are found so commonly in inland forests that a total population size of 2 million may be a conservative estimate. However, the total population size for each species and subspecies is much smaller. Several subspecies of the banded group langur group are among the most beautiful of all primates; due to difficulties in maintaining langurs in captivity, they are unlikely to be appreciated outside their small geographic ranges. The pigtailed macaque, gibbons and siamang have populations sizes of several hundred thousand. Rijksen (1978) estimates a *maximum* of 15,000 orangutans in Sumatra and stresses that the remaining undisturbed primary forest area is a *minimum* for the maintenance of a natural population. The pigtails, gibbons and siamang have larger distributions in Sumatra but, nevertheless, are dependent upon extensive tracts of relatively undisturbed primary forest for their survival. Small pockets of forest cannot sustain a stable population, and the apes will eventually become extinct in all such areas.

The greater mobility of pigtails provides them the option of travelling to another forested area. However, pigtails appear to be the least numerous of all the primates we surveyed (i.e., excluding the orangutan), and they are most likely to be killed as agricultural pests (personal observation). Longtailed

macaques also are killed as pests but with less perseverance. Even the langurs are subject to persecution, especially in rubber plantations where they can do great damage to the young trees.

The fact that guns are uncommon, coupled with Islamic prohibitions against eating monkey meat, has a great deal to do with the comparative abundance of primates in Sumatra. However, there are additional pressures on some species. In certain areas, especially West Sumatra, juvenile pigtail macaques are captured and trained to harvest coconuts and some other fruits. We observed 13 captive pigtails of which 10 were active workers. In contrast, we saw only three captive longtails, one of which was in training for coconut picking (longtails were reported to be "less clever", rarely becoming efficient workers). Interestingly, in some areas where pigtails were captured to pick coconuts, they were respected for their cleverness and not killed as pests.

The siamang was the primate species most preferred as a pet. Few people were aware of the laws which prohibit keeping these animals as pets. The pets we counted give little indication of the actual numbers removed from the wild since many others are exported (probably smuggled to Singapore), many die in captivity (as was reported to us), and the principle method of capture is to shoot a parent carrying an infant.

The present rate of primate decimation through capture is relatively insignificant compared to potential population declines resulting from habitat destruction. However, an additional impact on the macaques is their export for biomedical research. In light of the original goal of our survey, we made the following recommendations in our 1973 final report (Wilson and Wilson, unpublished manuscript):

1) *Macaca fascicularis* and *Macaca nemestrina* are valuable animals for use in biological research. The population of *H. fascicularis* in Sumatra can maintain itself in the face of considerable trapping and provide exports for many years. *M. nemestrina* populations are still strong enough to be exploited, but cannot support large scale trapping. For research projects *M. fascicularis* should be chosen over *M.*

nemestrina whenever feasible, the latter being reserved for studies where its larger body size and greater tractability make it more desirable for a particular experiment. Whenever possible, imported *M. nemestrina* should be assigned to captive breeding programs such as at the Primate Field Station of the Regional Primate Research Center at the University of Washington. Animals should be trapped in areas where farmlands are rapidly expanding such as the transmigration areas of Lampung Province in southern Sumatra. Instead of being killed as agricultural pests, the pigtails can be live-trapped by farmers, not only ridding them of pests, but giving them monetary returns. *M. nemestrina* from Sumatra are currently being trapped in these areas.

"Much has been written about great waste of primate resources through inhumane trapping and handling techniques and disease in overcrowded holding compounds before shipment. Rarely mentioned is the fact that the importers, in buying animals at the lowest prices, make improvements in the situation economically difficult even when dealers are enlightened and want to keep their animals healthy. When importers specify age and sex class limitations, the animals not wanted are either killed when trapped (in Sumatra they are clubbed) or die in the holding compounds. If importers are willing to pay more per individual, a larger proportion will survive in captivity for an overall savings in money and lives. Importers should also accept all age/sex classes when possible and estimate their needs farther in advance to reduce holding time before exportation." Since then, there has been some implementation of these recommendations, at least by the University of Washington Regional Primate Research Center. However, losses to farmers in terms of crops destroyed by pigtails do remain higher than any profits realized by the sale of monkeys captured in southern Sumatra. The capturing of entire troops has proven difficult.

In the United States, Europe and Japan the use of longtailed macaques in biomedical research has increased, as India has banned exports of the rhesus macaque. For example, longtailed macaques may soon be used in the testing of polio vaccine. In light

of projected increases in exportation, we urge that a long-range management plan be developed to prudently harvest rather than indiscriminately decimate the macaque populations of Indonesia. Our remaining recommendations were, briefly:

2) The protection of all ape species *(Hylobates, Symphalangus, Pongo)* should be enforced and intensified. This will involve education and forest protection. All of these species are dependent upon large tracts of undisturbed forest for self-maintaining populations.

3) Forest preserves should be established in Sumatra in each area with distinctive primate fauna (many other animal species with small distributions therefore will be protected as well). The most immediate concern to us in 1973 was regarding the establishment of a reserve on Siberut, largest of the Mentawai Islands, to protect an endemic primate fauna. Through the dedicated efforts of R. Tilson, WWF/IUCN, and the Indonesian government, this has now been achieved, at least on paper.

4) Reforestation programs should use a variety of indigenous primary forest tree species rather than pine trees *(Pinus)* which support few native animal species.

5) The people of Sumatra should be encouraged to refarm abandoned farmland whenever possible, instead of cutting down virgin forest. Large areas of the West and North Sumatran highlands and parts of South Sumatra and Lampung are deforested and abandoned. Sophisticated agrarian techniques will be required to reclaim much of this land.

In retrospect, these recommendations seem naive and optimistic. Sumatra is unusually rich in plant and animal life as well as being the homeland for a diversity of fascinating human cultures. Although Indonesia is also rich in natural resources, it will become more and more difficult to support a steadily increasing human population, already one of the world's largest. The conflict between economic/technological development and the preservation of nature in Indonesia is likely to become more heated in the near future. The outlook is pessimistic. Forest reserves that are protected only after they have been selectively logged are not sufficient. Such forests are ugly, and some plant and animal species will decline in numbers or disappear (Wilson and Wilson, 1975; Rijksen, 1978). Conservation will be a widespread phenomenon only when it is economically the most attractive alternative– –and that may never happen.

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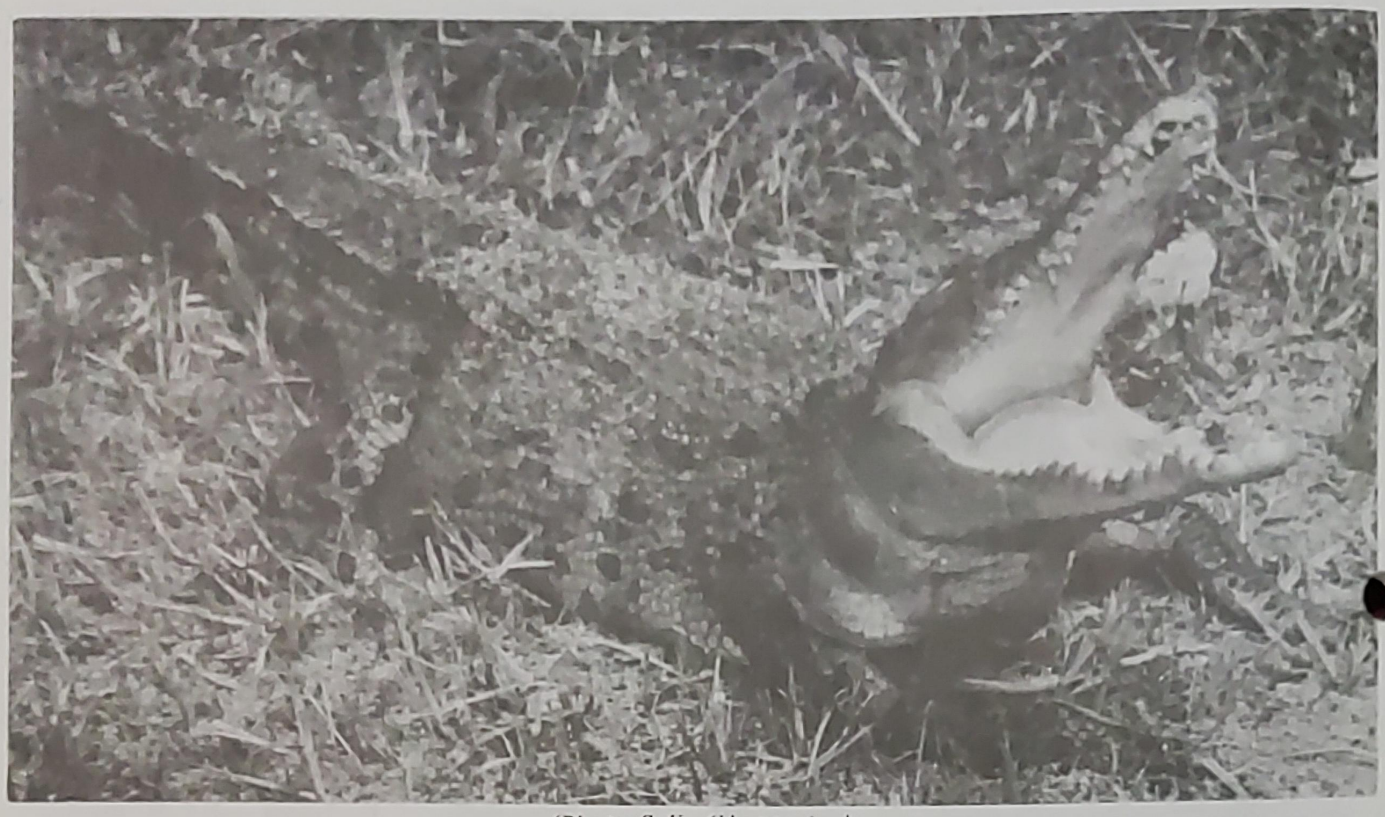

(Photo: S. K. Chatterjee)

KAKADU – A SANCTUARY FOR CROCODILES?

by Graeme Wells

"On our course up and down the river we encountered several very large alligators, and some were noticed sleeping on the mud.....and as they appeared to be very numerous and large, it was not thought safe to stop all night up the river."
P. P. King describing "alligators" in the East alligator River (1818) in *"Narrative of a survey of the intertropical and western coasts of Australia, 1818–1822"*, Vol. 1.

The Alligator Rivers lie within the boundaries of the Kakadu National Park in the Northern Territory. In 1977 and again in 1978, surveys to determine current status of salt-water crocodile *(Crocodylus porosus)* populations in the area were undertaken by the University of Sydney-Territory Parks and Wildlife Commission's Joint Crocodile Research Project. Increasing levels of disturbance to the regional ecosystem, both human and feral animals (buffaloes, pigs), the possibilities of uranium deposits in the area being mined and considerations for the then proposed Kakadu National Park were taken into account in determining survey priorities.

Table 1 provides a breakdown of the total number of *C. porosus* observed, total numbers of hatchlings on each system in consecutive years and densities of crocodiles for the individual systems. Inspection of the numbers shows no significant increase in *C. porosus* during 1977-78. The input of hatchlings into Murgenella Creek, West Alligator and Wildman Rivers shows that some recruitment is occurring in these systems. It must be remembered that *C. porosus* are subject to considerable mortality, especially during the first year. Recovery of the population cannot be expected until those individuals that are presently juveniles begin to reproduce. *Salt-water crocodiles do not reach adulthood until around 15 years of age!* Until this time, we can expect at best a very slow recovery as a relatively small number of adult crocodiles remain in the wild. Prospects for survival of the crocodiles differ between rivers, so each system is described individually below:

East Alligator River System (Tidal Portions)

During the 1977 survey, some 318 salt-water

crocodiles (including 53 hatchlings) were seen on the tidal portions of the East Alligator River system. In 1978, 329 *C. porosus* (including 39 hatchlings) were sighted. The highest density of non-hatchling *C. porosus* yet found by the survey team in northern Australia occurs in the short tidal portion of Magela Creek which enters the East Alligator River. 20 *C. porosus* were seen in Magela Creek in 1977, while 17 individuals were sighted in 1978.

Broad leaved grasses, in particular *Ishaemum australe* var. *villosum* and *Imperata cylindrica*, once common along the concave portions of river meanders, have been trampled and overgrazed by buffaloes. Such grasses once provided nesting materials and suitable nesting areas for *C. porosus*. Only a limited number of suitable nesting areas remain today. Continual loss of nesting habitat for the salt-water crocodile along the tidal portions of the East Alligator River system could well be a major contributing factor limiting of the remaining remnant population. *Continual loss of nesting habitat implies that recovery of the population is not assured.*

South Alligator River System (Tidal Portions)

During the 1977 survey, only 142 *C. porosus* (no hatchlings) were seen on the tidal portions of the South Alligator River System. In 1978, 157 individuals (including 6 hatchlings) were sighted. In the tidal portion of Nourlangie Creek, which enters the South Alligator River, 15 and 16 salt-water crocodiles were counted in 1977 and 1978, respectively. The density of non-hatchling *C. porosus* in this system in 1977 was 1.3 crocodiles/km. This is an extremely low density for a large river system in northern Australia. In recent years, numerous persons have stated that the South Alligator River never held a large crocodile population and this might be true for the last few decades, but it should be remembered that the East and South Alligator Rivers were so named by Captain King in 1818 due to the great abundance of "alligators" in these systems.

It appears that since these early times, shooting, baiting and the near total loss of fringing riverside vegetation (primarily due to overgrazing by buffaloes), has contributed greatly to the demise of the salt-water crocodile in this system. To travel some 113 km. up the South Alligator River to find only 157 crocodiles is a sad experience. In some river systems in northern Australia, you can expect to find this number of individuals in 15 km. Table 1 shows that recruitment of *C. porosus* within the tidal portions of the South Alligator River is negligible. Taking into account the loss of suitable nesting habitat along this system, the survey results are not surprising. *The chances of this system recovering are minimal.*

West Alligator River (Tidal Portions)

The tidal portion of the West Alligator River is

TABLE 1

Survey results of salt-water crocodiles in tidal portions of river and creek systems in the Alligator Rivers area, Northern Territory. – after Messel *et al*, 1979

River or Creek System	Total Crocodiles		Total Hatchlings (crocodiles less than 1 year old)		Density/km of river	
	1977	1978	1977	1978	1977	1978
Murgenella Creek (wildlife sanctuary)	95	173	1	48	2.0	2.7
Coopers Creek	82	84	4	12	2.2	2.1
East Alligator River	236	245	49	27	2.2	2.6
South Alligator River	142	157		6	1.3	1.3
West Alligator River	83	85	9	23	1.8	1.5
Wildman River	not surveyed	118	not surveyed	53	not surveyed	1.9

relatively short (42 km) with numerous sidecreeks. During the 1977 surveys, 83 *C. porosus*, including 9 hatchlings, were seen. In 1978, 85 individuals, including 23 hatchlings were sighted.

Fringing riverside vegetation along tidal portions of this river system have not as yet been greatly damaged by buffaloes. *The potential for recovery of the salt-water crocodile population in this system is good providing habitat is not further damaged.*

Wildman River

The Wildman River forms part of the western boundary of the Kakadu National Park and was first surveyed during 1978. Some 118 *C. porosus* (including 53 hatchlings) were seen. Fringing riverside habitat along the tidal portions of this river system is still in a reasonable state of preservation, although some buffalo damage is evident. *The potential for recovery of the salt-water crocodile population in this river system is good.*

The surveys carried out show that there is a minimum of 706 salt-water crocodiles residing in the 309.3 km. of tidal waterways surveyed that are included within the boundaries of the Kakadu National Park. Some 17.4% of this total represents hatchlings and this figure shows that recruitment is occurring in the populations. It should be remembered that many of the hatchlings will die from natural causes and the figure of non-hatchling salt-water crocodiles observed in the systems is 583. Overall density of non-hatchling salt-water crocodiles in the area surveyed within park boundaries is 1.89 crocodiles/km of river.

A three year calibration study (involving some 204 repeated surveys of specific areas) to determine what percentage of salt-water crocodiles actually present in a system are subsequently observed on a particular survey has been undertaken by Professor Harry Messel of Sydney University. He found that, depending on the state of the tide and season of the year, up to 40% of crocodiles are missed on a survey. Applying the maximum correction of 40%, an estimate of some 988 salt-water crocodiles is arrived at for tidal waterways surveyed within the boundaries of the Kakadu National Park. For the same area, an estimate of 816 crocodiles (over one year of age) is obtained. This is perhaps the more realistic total. Crocodile numbers for Murgenella Creek (173 crocodiles, including 48 hatchlings) have been excluded from these calculations, as Murgenella Creek lies outside the Kakadu National Park boundaries.

There appears to be a viable but presently static salt-water crocodile population remaining in the tidal portions of the Alligator Rivers area. Even though the Alligator Rivers fall within the boundaries of the Kakadu National Park, this does not mean that survival of the species in this area is assured. Only if the spread of buffalo can be kept in check – particularly in the swamplands bordering the river systems – will suitable nesting areas for salt-water crocodiles remain undamaged. Buffaloes also destroy the habitat of many waterbirds and small mammals that live in the area.

Legal gill netting for fish – principally barramundi *(Lates calcarifer)* occurs in the estuaries of all the rivers in the National Park, and a number of salt-water crocodiles drown each year in fishermen's nets. Most *C. porosus* lost in this manner are either adults or individuals nearing adulthood. Fortunately, many *C. porosus* residing in the estuaries have become net-shy. As large salt-water crocodiles frequent the mouths of tidal rivers (Webb and Messel, 1978), the netting within the estuaries of the Kakadu National Park is an extra hazard affecting survival of the crocodile population.

With adequate protection and monitoring of salt-water crocodile populations and their nesting habitat in the Alligator Rivers area, visitors, both national and international, should, within a decade, be able to cruise down these tidal rivers with their primeval fringing mangrove forests and witness numerous basking saurians along the river banks. In years to come, such a sight could well show Australia's concern for vanishing species of wildlife.

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COASTAL LAND DEVELOPMENT

A SHADOW OVER THE

GREAT BARRIER REEF (AUSTRALIA)

by Norm Bennell

As the Great Barrier Reef Marine Park Authority moves towards preparing its first zoning proposal for Reef section, the widest possible range of environmental management factors is being taken into consideration.

While the Authority's direct responsibility is for a marine park, its work is inextricably bound up with many other related issues. Not the least of these is the effect of land-based development in coastal areas and on islands adjacent to the Reef.

Whatever land-based development occurs in coastal zones adjacent to the Great Barrier Reef is the responsibility of the State of Queensland. The Authority's statutory powers do not interfere with the traditional state role. However, scientific information and other data being collected by the Authority will be available and could be used by Queensland in relation to coastal development decisions and the desire to protect the reef region.

The Authority's statutory obligations revolve around control, care/development and management of a marine park within the defined Great Barrier Reef region. These require research and investigation of factors which might have direct or indirect significant effects on the reef region.

It is widely believed that there is an obligation on the Authority to take into account coastal land uses and proposed uses and development where these have a real or potential impact on the reef region. The impact of coastal land-based development has a direct and potentially enormous bearing on the statutory responsibilities of the Authority in relation to zoning and management decisions for the marine park. Conversely, decisions of the Authority in relation to the Great Barrier Reef Marine Park could influence decisions made by other agencies and bodies involved in the management of coastal zones adjacent to the Great Barrier Reef.

Current Information

Not only is the Great Barrier Reef with its islands and waters an integrated indivisible natural system, it is ecologically connected with its adjacent coastal zone. There is a lack of reliable information about the effects of coastal land-based activity on the long-term maintenance of the Great Barrier Reef. In the field of the biological and physical sciences more information is needed about reef processes, growth, animal and plant population dynamics, water movements, coast/reef interactions, catastrophic events and geological processes. Very little is known about the economic importance of reef usage, patterns of

Plankton feeding fish face a threat to their food supply from land-based fertiliser run-offs. (GBRMPA photo)

A reef flat- an area very sensitive to siltation from land-based activity. (GBRMPA photo)

use, and likely increases in use. The Great Barrier Reef Marine Park Authority is attempting to overcome this information deficiency.

Before recommending the declaration of a marine park section, the Authority, besides researching reef uses, examines certain coastal zone activities that affect, or have the potential to affect, areas being recommended. Investigations of this nature began in 1976 in connection with the declaration of the Capricornia Section of the Great Barrier Reef Marine Park, which covers the southernmost part of the reef around the Capricornia and Bunker Groups.

Land Uses and Effects

Coastal zone activities relevant to both the pre and post-declaration phases of the Marine Park are numerous. These and their impacts include:

- tourism (general)– beneficial effects such as increased knowledge of the Reef; adverse effects resulting from over-use at specific locations.
- tourist developments (infrastructure) – adverse effects related to, for example, sewage outfalls.
- urbanisation and industrialisation-adverse effects of water-borne pollution.
- port development and coastal shipping – effects due to risks of increased ship movements, for example, oil discharges, oil spills and release of other toxic cargoes.
- development in areas of mangrove, salt marshes, and wet lands – adverse effects on marine life, on fish and prawn refuges and nurseries, and on the habitat of migratory birds.
- agriculture – adverse effects due to soil erosion, siltation and salinity changes, and run-off of excess agricultural chemicals (pesticides and herbicides).

The accompanying table illustrates what could be the actual and/or potential ecological dangers of one uncontrolled coastal zone problem, water pollution, which affects the Reef. Many of those ecological effects are subsequently transmitted into economic and social effects, for example, loss of fish productivity and recreation value.

Despite a lack of substantiated information, long-term reef users have noted changes in fish populations, increase in algal cover, decline in water clarity and changes in coral communities. In other parts of the Pacific these changes have been symptoms of polluted or seriously disturbed coral reefs.

Co-ordination and Co-operation

Understanding and regulation of indirect im-

pacts on the complex ecosystem of the Great Barrier Reef is a task of considerable difficulty which will involve major scientific and management research programs, and co-operation among several agencies.

The effective way of achieving the objectives of control, care and development of a marine park within the Great Barrier Reef region is through integrated management processes covering the islands, reefs, waters and coastal zone of the region.

This is provided for in part by the power of the Authority to "perform any of its functions in co-operation with Queensland, with an Authority of that State or with a local governing body of that State." (s.8(3)). Further provision is made for the Authority to make arrangements with Commonwealth or Queensland Government agencies for the performance of functions and exercise of powers under the Act. (ss. 42(1) and (2)).

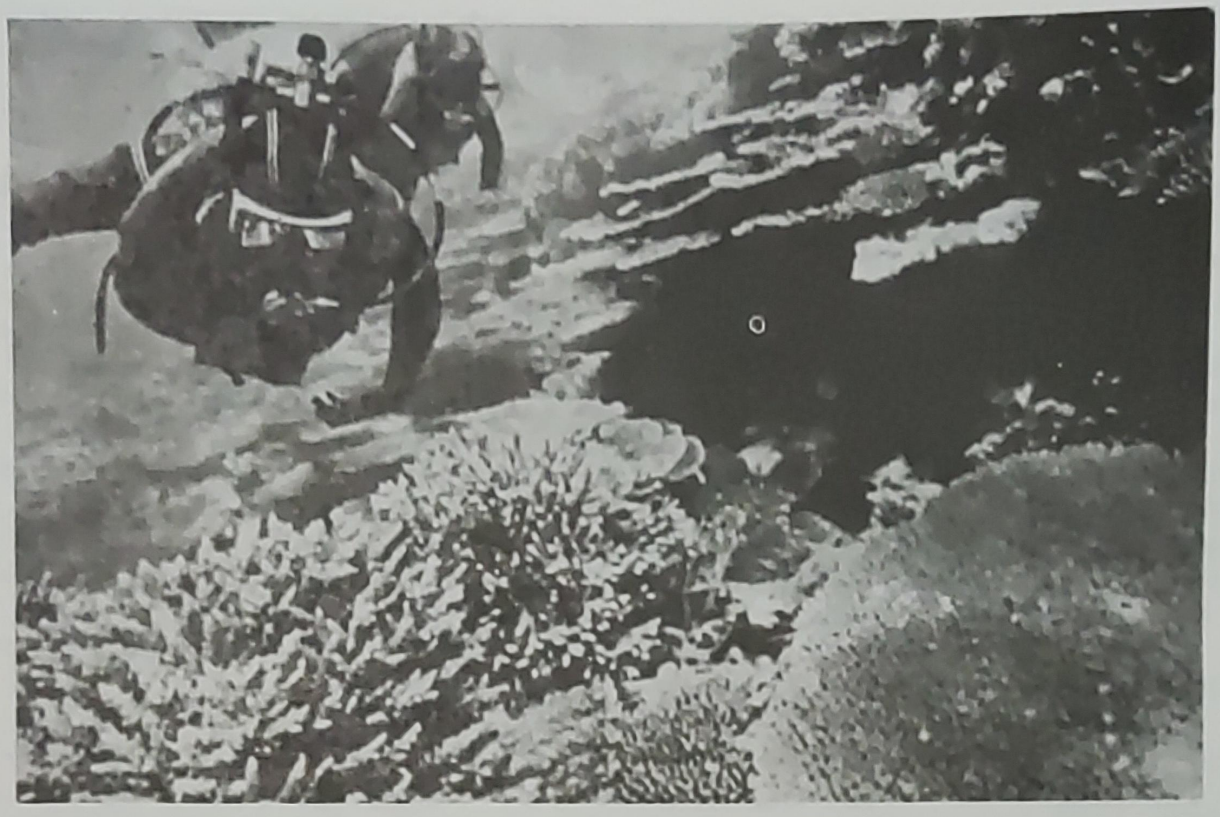
The Authority has actively pursued collaborative arrangements with Queensland Government agencies, particularly in the fields of national park management, fisheries management, tourism, research and interpretative education. As areas of Marine Park are declared, the co-operation will continue into procedures of regulation and enforcement.

The Prime Minister and the Queensland Premier announced on 14 June, 1979 that, as sections of the Great Barrier Reef Marine Park are proclaimed, the day-to-day management will be undertaken by officers of the Queensland National Parks and Wildlife Service who, in discharging these responsibilities, will be subject to the Great Barrier Reef Marine Park Authority.

The Authority continues to have responsibility for:

- recommending the declaration of parks
- developing zoning plans and plans of management
- arranging for research and investigation relevant to marine parks.

Category of Coastal Zone Activity	First Round Effect	Sequential Effects
Municipal waste water discharge	1. increase in suspended solids	— decreases in water clarity — hinders photosynthesis — direct deleterious effect on fish and other aquatic life by the coating of gills or blanketing bottom organisms.
	2. increase in biologically degradable organic matter.	— depletion of oxygen which affects fish growth and reproductivity and other aquatic life. — change in composition & diversity of aquatic life.
	3. increase in nitrogen, phosphorus, carbon iron & trace metals.	— nutrient increase causing algal growth. — subsequent algae cell deaths use oxygen in decomposition and can kill fish and other aquatic life.
	4. increase in faecal coliforms (pathogenic bacteria & viruses).	— taken up by water can render fish unfit for human consumption, or affect human health if fish eaten.
Industrial waste-water discharge	1, 2, 3, 4 as above 5. increase toxic compounds — heavy metal (mercury, copper, silver, lead, nickel, cobalt, arsenic, cadmium, chronium etc.) cyanides, sulphates, fluorides and petrochemical wastes.	— as previously stated for First Round Effects 1 to 4 inclusive. — can kill aquatic biota. — can be biomagnified in the food chain.
Agricultural waste	1, 2, 3, 4, 5 as above	— as previously stated for First Round Effects 1 to 5 inclusive.
	6. introduce pesticides and herbicides	— as stated for increase in toxic components (First Round Effect 5).
	7. introduce fertilisers	— as stated for First Round Effect 3.
Soil erosion	1. above	— sediment loads can affect aquatic life. — settled solids as sludge deposits cause changes in benthic ecosystems.
Accidental spillage of oil and other hazardous materials	5. above	— as previously stated for First Round Effect 5.
Dredging	1, 2 above	— as previously stated for First Round Effects 1 and 2.



Divers examining leeward reef edge as part of GBRMPA survey and monitoring program. (GBRMPA photo)

Zoning and Public Participation

After declaration of a section of the marine park, the Authority is required to present a zoning plan for public comment in respect of that area.

The Authority has a policy of encouraging public participation in all its processes, going beyond the statutory provisions of the Act which require public consultation only in relation to zoning.

Coastal modification through human activity such as tourism, urbanisation, industrialisation, harbour development, dredging, agriculture and sewage discharge can affect the ecology of the Great Barrier Reef. They also threaten pollution and habitat destruction.

The complexity of these issues, as well as the multiplicity of uses of the reef itself, make the information gathering and public participation programs essential to reaching the right decisions on reef protection and uses.

Research and investigatory activities continue after declaration, during the zoning process, and later as inputs to management. The Great Barrier Reef Marine Park Authority is not a scientific research body in itself but is a co-ordinator, seeking ways and means of supporting research by other institutions and individuals.

The accumulation of data, whether directly concerned with reef or with associated activities, such as land-based development, is an on-going process.

The Authority's interest in coastal developments can increase once declaration, zoning and regulation have been effected. As well, the management of the reef region by the Authority has the potential to affect, to a degree, reef-related activities on the mainland.

Therefore, the management techniques for the projected Great Barrier Reef Marine Park will be different in application compared to other national parks. The Marine Park can never be managed entirely as an isolated entity. Although there are defined boundaries and the protection of law, it cannot use natural or man-made barriers to ensure its survival and will depend on measures to protect it from external influences as well as carefully regulated activities from within.

The author is with the Great Barrier Reef Marine Park Authority.

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CRISIS IN THE MALAYSIAN ENVIRONMENT

"**Crisis in the Malaysian Environment**" is a 16mm 21-minute colour film produced by the Consumers' Association of Penang on the present crisis of the environment in Malaysia. It is one of the first films ever produced by a developing country on the environmental crisis of our times.

Man is, first and foremost, a consumer of his environment. If environmental conditions deteriorate, then there is also a deterioration in the quality of life and even the prospects of survival of Man.

In Malaysia, there has been a rapid deterioration of the environment in recent years as a result of industrialization, land, mismanagement and urbanization. The film focuses on various aspects of this environmental deterioration in Malaysia : the pollution of river and seas (which are destroying fish life and threatening the health of millions of villagers); rapid deforestation; sewage disposal; land mismanagement; urban congestion; and air pollution.

Case studies of three villages affected by industrial pollution and land mismanagement are also presented.

The nature of the film is educational. It is suitable for screening to educationists and students, scientists and planners and all those concerned about the environment in Third World countries. The commentary has been kept simple and clear as it is aimed at the general public. It is hoped that the generation of awareness will be the first step in solving the critical ecological problems that are now facing Malaysia and many other Third World countries.

"**Crisis in the Malaysian Environment**" is now on sale at M$1,000.00 or its equivalent.

For further details please write to:

Khor Kok Peng
Research Director
Consumers Association of Penang
27, Kelawai Road, Penang, Malaysia.

SPC ENVIRONMENTAL EDUCATION FILM RELEASED

The first educational film produced by the South Pacific Commission has now been released after two years in production.

Titled *Story of an Island: Managing Your Island Environment,* it tells the story of a typical tropical island and how its environment changes from the original undisturbed state to the present. It shows the environmental destruction that can result from bad resource management practices, and illustrates what this can mean for the future of the island. It also demonstrates principles of good environmental management, and tells how rural islanders, both young and old, can work to protect village resources.

The film is intended for rural adult and youth audiences in the Pacific Islands, but it could also be useful in other island areas with similar conditions. It may be used in conservation programmes, in agricultural, forestry and fisheries extension activities, and in school programmes. The editing and narration were designed to be easily understood by rural audiences. The film was made by Island Image Productions Noumea, for the South Pacfic Commission, using footage shot in Western Samoa, New Caledonia and the Loyalty Islands. It shows fishing, gardening, and other resource use, as well as problems like erosion and water pollution. Logging is used as an example of major development projects. The actual scenes showing different Island peoples are mixed with views of a model island which goes through many stages from virgin purity to total environmental collapse or sustainable resource management.

The film is intended to raise questions and to encourage discussion more than to provide specific answers (which local people should do for themselves). It aims to help people re-examine their present use of resources (land, sea, water, plants and animals), and to think about the direction development is taking on their island.

This is a 16 mm colour film with optical sound track (in English), and is 45 minutes long. A French version will be available later in 1980. Prints are being given by SPC to each country in the area for which SPC works. Copies are also available on loan within the SPC area from the Librarian, South Pacific Commission, Noumea. Prints may be purchased from SPC at cost, presently CFP 25,000 (A$300), or less if more than one print is ordered at a time. A written script is available with the film so that a narration can be arranged in local languages.

from **Environment Newsletter** *No.3 – Feb. 1980*

PERE DAVID'S DEER: THE TREK FROM EXTINCTION

Extinct in the wild for more than three thousand years, this unique species of deer now survives only in wildlife refuges.

by Janet Newlan Bower

Three thousand years ago, in northern China, a large water-loving deer glided from its marshy homelands into extinction from the wild. The few of these deer not dispossessed from their natural habitat and hunted into extinction were held in a private game reserve for the pleasure of the Chinese Imperial Household. Today the species numbers more than eight hundred—a captive world herd built from fewer than two dozen head at the turn of this century.

The story of the struggle to save this unique species must begin in 1865. Before then western civilization did not know of the existence of this ancient animal. Early that year the mission/naturalist Pere Armand David peered over a high wall and into the only surviving herd of a hundred or more strange-looking deer.

So unusual was their appearance that David at first thought they were a new species of reindeer. He described them as "a kind of large reindeer of which the female is antler-less. For a long time I have tried to obtain a specimen of this variety of *cervidae*, still unknown to naturalists, which I know to exist in large numbers and for centuries in the Imperial Park Hae-Dze a few *li* to the south of the capitol." [He was referring to the Imperial Park *Nan Hai-Tzu* (the Southern Marsh), a mile south of Peking.]

David's attempt to acquire a specimen of this deer, which the Chinese called *Ssu-pu-hsiang*, was no small effort. It was forbidden by law, under penalty of death, to enter the park or to look over the forty-five-mile-long wall that encircled the Emperor's hunting grounds. Even removing remains of the animals could result in the same punishment. The park contained a small village and large herds of deer and gazelles. These herds were supposed to be protected for the purpose of the Emperor's hunting pleasures. However, David was told that no hunt had ever taken place there.

Despite the careful protection given the herds, the Tartar guards did add variety to their diets at the expense of the park's inhabitants. After nearly a year of persuasion, guards sold David the hides and bones of two *Ssu-pu-hsiang* for twenty *taels*.

Professor Milne-Edwards examined the specimens. It was he who announced to the world that a new species of *cervidae* had been discovered, a species whose history and origin was totally unknown. As was his prerogative as first describer, he named its genus *Elaphurus* and gave it the specific name of *davidianus* after Pere David. This species is the only member of its genus. Milne-Edwards mistakenly gave it the common name "milu," a name applied to sika deer. It is still commonly referred to as milu in Europe. Pere David's (or Father David's) deer is its popular name in English-speaking countries, however.

Pere David later gave the deer a new name of his own, *Cervus tarandoides*. This name referred to the deer's peculiarly branched antlers in which the anterior fork is sub-branched as in reindeer. But his scientific name for the species was suggested after that of Milne-Edwards and hence has never been recognized as the valid one.

Who was this curious naturalist for whom so rare a deer was named? Born September 7, 1826, in the small French town of Espellette, Armand David was one of four children. His father was a doctor, justice of the peace, and Mayor of Espellette. Like his father, Armand David was an enthusiastic naturalist.

Text and artwork reprinted by permission from National Parks & Conservation Magazine, *April 1979. Copyright c 1979 by National Parks & Conservation Association.*

His greatest ambition, however, was to work with the Church. At age twenty-two he entered the Congregation of the Lazarist Mission. After his admission, he was sent to Savona, on the Italian Riviera,where he conducted a course in natural science and started a natural history museum.

After years of waiting, he was sent in 1860 to open a French school in Peking. Before sailing, David was commissioned by Milne-Edwards of the Musee National d'Histoire Naturelle to obtain scientific specimens for the Academie de Sciences.

During his fourteen-year span of work in China, David collected about three thousand species of plants. He recorded more than two hundred kinds of mammals. Except for domestic animals, only five or six of these mammals were identical to their European representatives. Even today, thanks to David's efforts, the Musee National du Jardin des Plantes in Paris is one of the best stocked museums of Chinese natural history.

Eventually David applied for permission to the Lazarist Congregation to make longer expeditions into little-known parts of China. It was on one of these trips that he discovered the giant panda *(Ailuropoda melanoleuca)*.

By 1874 Pere David was forced to return to Paris because of recurring bouts of malaria. Home again in France, David taught natural history; he also founded a museum of natural history for the use of young missionaries.

By the time of his death in 1900 Armand David had been made a corresponding member of the London Zoological Society. He had been awarded two gold medals, one from La Societe de Geographie, the other from La Reunion des Societes Servants de ce a la France Sorborne. He accepted the Cross of the Legion of Honor in 1896, having declined it several years earlier.

During the twenty-five years following David's discovery of the strange deer, several European countries, including France, England, and Germany, were able to acquire a few of these new deer for exhibit and had some small success in breeding. There was little concern for the safe continuation of the herd inasmuch as it had apparently existed for centuries within the Imperial Park with great success. Then catastrophe struck.

The Hun-Lo River, flowing through the Imperial Park, flooded in 1894, destroying several areas of the ancient walls. Most of the Pere David's deer escaped into the surrounding countryside, where they were killed and eaten by drought-starved peasants. The few remaining deer were slaughtered by Allied troops in the Boxer Rebellion of 1900.

In 1917 a pair of Pere David's deer was found to have been preserved in one of the Manchu palace's, extensive grounds. Put on display in a zoo in Peking, by 1922 they both were dead, apparently because of neglect.

Startled by the decimation of such a rare animal, European collectors agreed to sell their individuals to Herbrand Arthur, the Eleventh Duke of Bedford. It was hoped that this expert on deer could save Pere David's deer from total extinction.

The Duke's estate, Woburn Abbey, rambled over several thousand acres of English countryside. His success in preserving wildlife had been demonstrated by the acquisition of a pair of Pere David's deer in 1898 and the subsequent birth of a male offspring, "Solomon."

During the next few years the Duke acquired a total of eighteen head—ten males and eight females. Of the base herd of eighteen, three apparently never bred. The present world herd is probably descended from not more than fifteen animals.

By the mid-1940s the Twelfth Duke of Bedford became concerned over the safety of such a rare collection housed entirely in one area. England had already seen two world wars since the inception of the herd. It was decided to start dispersing the original herd to ensure the preservation of the species. In 1945 a group of seven day-old hand-raised fawns was sent to Whipsnade Park, the London Zoological Society's country zoo.

Two pair of Pere David's deer were sent to the New York Zoological Society in 1946. The first birth of a Pere David's deer in North America occurred in 1949. Within the next few years other individuals were sent around the world. The Smithsonian Institution maintains a breeding herd in the Virginia countryside at Front Royal near Shenandoah National Park.

Because of the dedication of the Eleventh Duke of Bedford and his successors, the Pere David's deer seems safely preserved for mankind today. At present the species totals 871 head in eighty-eight collections around the world. Woburn still maintains the largest herd with 178 deer.

The species came full circle in 1956 when two pair of *Ssu-pu-hsiang* were sent to Peking from the London Zoological Society. In 1957 the first calf in more than half a century was born in its native Chinese homeland.

To the Chinese, *Ssu-pu-hsiang*– "four characters that do not fit together" –was an ideal name for the Pere David's deer. Its antlers seem to point the wrong way. Its large hoofed feet are like those of a cow. Its long curved neck is similar to a camel's. Its lengthy tufted tail is like that of a donkey.

Pere David's deer are large, standing four feet high at the shoulder. Males weigh about 350 pounds,

females about 250 pounds.

The summer and winter coats are usually highly contrasted. Warm weather, usually late April or early May, brings a bright red coat with a blackish stripe along the spine and over the shoulders. Summer coats, however, may run to a dull gray color. Winter coats, appearing in August, are usually iron gray with fawn shadings. A very soft, fine wool undercoat helps the deer to survive bitter cold temperatures.

The ears are small for a deer, the face long. As the Twelfth Duke of Bedford wrote, the combination produces a "melancholy expression enhanced by Pere David's deer's habit of spending long periods just standing about doing nothing in particular."

Lydekker described this species' general carriage as slouching, with head low like a cow's rather than high like most deer. Bedford took exception to this description. "That it does not hold its head high, is true only when the animal is undisturbed and moving at a walk. When alarmed Pere David's hold their heads as high as other deer and move off at a high actioned trot, elevating the tail and breaking into a gallop if still further alarmed."

The deer's antlers are considered its most unusual physical characteristic. They seem to be worn backward. Instead of forward-pointing tines, there is an extremely long back tine. A second shorter tine above the first also points back, the beam ending in an upright or short lateral fork. Often there are a number of "curious knobs, excrescences and short tines scattered about the beam and larger points which cause Pere David antlers to resemble the dead branches of a tree."

The set is hardened by May, in time for the rut. Most experts believe that the David's antlers are used more for domestic purposes than for fighting. They are frequently used as "back scratchers." Deer also have been observed using the long tine as a scoop for lifting mud. The mud, once deposited on the center of his back, runs down the animal's sides in cooling streams.

Yearling Pere David's stags grow simple spikes. These antlers are short and usually identical in length among the individuals. At this point they have no burr. The full head is acquired when the stag is about six years old.

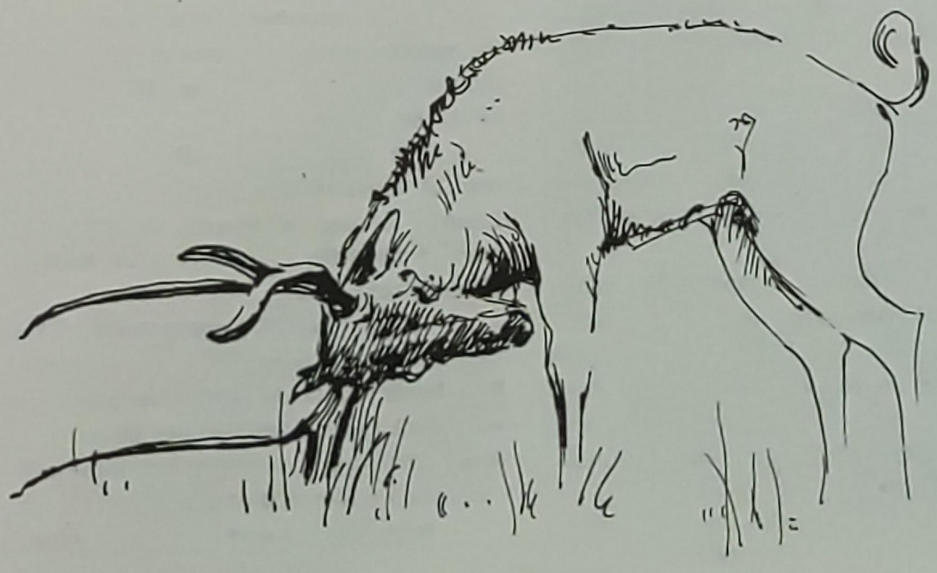
The antlers are usually quite hard, with the inner section of ivorylike material. Ancient Chinese used it, much like ivory, to carve ornaments. Tools such as picks, points, and awls made from these antlers have been found in centuries-old ruins.

The most remarkable characteristic of Pere David's deer is the stag's ability to grow two sets of antlers in a year.

The Duke reported this occurrence from the turn of the century to World War I. The two sets of antlers are smaller than the set that occurs once a year. The summer pair was shed in October or November. By Christmas, a short simple pair consisting of a back tine and terminal fork would harden. These would drop after a few weeks. The summer set was hardened by May.

Bedford attributed this phenomenon to good health and proper diet among the stags. After the extremely poor feeding arrangements forced upon Woburn during the war, at which time half the herd starved to death, the trait ceased.

The physical characteristics of Pere David's deer have their humorous as well as unique aspects. Bedford recalled, "I once saw a Pere David stag suffer a ludicrous minor accident to which a Pere David alone could fall a victim. In scratching his rump with the long back tine of one of his antlers he got his tail wound round the tine in such a way that he became



so securely anchored, fore and aft, that I was just starting off to fetch assistance in releasing him, when he managed to unwind his caudal appendage from his horn!"

The rut occurs in June and July. Once the stag joins his harem of hinds, he fasts. Eventually, after several weeks of fasting, he is forced out by stags in better physical condition. Once having left the hinds, his strength returns quickly.

These deer do not use their antlers a great deal in fighting. Rather, they bite and slash, using their teeth. They also stand on their hind legs and "box."

The stags separate from the females for about two months before the rut and two months after. During the remainder of the year the herd remains together.

The gestation period for Pere David's deer is 250 to 270 days. Usually one (occasionally two) fawn is born in April or May.

Hinds frequently bear their first offspring at two and a quarter years of age, and they continue to breed until they are in advanced age. Stags are usually three years old before they participate in the rut. The life span of a Pere David's deer is about twenty years.

These deer enter winter in excellent condition. Fawns have been weaned by late summer, and the stags have regained their strength after the rut.

Water is a favorite element of Pere David's deer. Individuals may be observed standing, lying, even playing in it. This affinity for water, the deer's desire for water grasses and reeds, and its physical characteristics lead experts to believe that the species' habitat in the wild was the Chinese marshlands. The difference in length of time in which the summer and winter coats are carried seems to indicate that the deer's original homeland was in colder areas. The same argument for such an origin using the width of the hoof and its similarities to that of a reindeer has been made. Such hoof formation would be ideal for travel over snow as well as in marshy areas.

It is believed that numerous herds wandered over a triangular flatland area of Eastern Asia formed by the Yellow River and lesser rivers. The area ran from east of Peking in the north to the Ch'ien-T'ang River estuary in the south, and from Lo-Yung in Honan Province in the west to as far east as Japan (Japan having been joined at one time to the Asiatic land mass).

As Chinese agriculture advanced, the swamps were drained and reeds cut back, thus destroying the deer's natural habitat. It is possible that the area that became the Imperial Hunting Park was the deer's last natural territory. The *Ssu-pu-hsiang* has been extinct in the wild since the Shang Dynasty (1765–1122 B.C.).

Nowadays Pere David's deer is preserved only in wildlife reserves. But this situation may be only a temporary respite from the threat of extinction. Politics, natural disease, economic conditions-captive populations are at the mercy of all these phenomena.

The flooding of Hun-Lo and the Boxer Rebellion were only two of the survival problems this species has faced in the past century. During World War I the British government opened Woburn to sheep and cattle. The resultant overgrazing combined with an inadequate supply of hay for winter feeding meant a severe food shortage. Pere David's deer were particularly hard hit. Only staunch fighting by the Twelfth Duke prevented the same tragedy from occurring again during World War II. In the spring of 1959 an outbreak of malignant catarrh destroyed half the herd of Pere David's deer at Whipsnade.

Any species that survives only in a captive condition should be designated as "endangered," yet the IUCN **Red Data Book** does not include Pere David's deer on its list of endangered species.

Continued planning is vital to assure that Pere David's deer will survive for future generations. The Pere David Workshop, sponsored by the Smithsonian Institution in early May 1978 at Front Royal, Virginia, was the first conference of its kind. It was primarily concerned with nutrition, management techniques,

general exhibit conditions, and inbreeding problems. The experts attending exchanged ideas and information that could give Pere David's deer a more permanent footing in the modern world. But much more needs to be learned about this species. Why do hooves need to be shod in one herd and not in another? Why does a female in the Brookfield Zoo have an antler growth on the left side measuring some six to eight inches? Why does one stag in a herd grow two sets of antlers in a year while other stags in the same herd grow only one set?

This species' struggle to survive is a warning and a goal to mankind. How many species have been lost over the centuries because of man's activities? Are we willing to sacrifice and adjust in order to keep the wildlife that is so much a part of our natural heritage? With such reminders we may better understand our part in the ecological development, without them we have nothing but ourselves.

Extinction is final.

Free-lance writer Janet Newlan Bower's interest in wildlife and conservation was greatly influenced by the proximity of the zoo, wild animal park, aquarium, and Sea World in her native San Diego. Artist Lucia de Leiris specializes in wildlife art; she spent the summer of 1978 sketching and recording social interaction of the captive breeding herd of Pere David's deer at the Smithsonian Institution Conservation Center in Virginia's piedmont near Shenandoah National Park.

DANGS FOREST – NEGLECTED TIGER RESERVE

by Dr. G.M. Oza

We have endangered the Bengal or Indian Tiger (*Panthera tigris tigris* Linnaeus, 1758) by destroying its thorny, dry and moist deciduous, semievergreen and evergreen forest cover, including the grasslands. It occurs throughout India from the Himalayas at an altitude of about 2,100–2,400 m. to Cape Comorin, excepting the deserts of Rajasthan, the Punjab and Kutch. Indiscriminate clearing of our rich forests for agricultural purposes, exotic plantations in its habitat and the tremendous progress of science and technology come in the way of conservation of this species. If this continues for a long period and inviolate reserves to maintain truly viable populations are not established soon, the Indian Tiger may head towards extinction.

International efforts are already in operation to save the tiger from extinction since it has suffered a catastrophic decline in numbers in all countries within its range; there may, probably be no more than 5,000 animals of the eight races remaining in the wild.

The situation is more delicate and dangerous, for the surviving populations are at the moment too scattered to maintain viable breeding populations for the future. There a has been a tremendous destruction of Indian forests, hence international efforts to save the tiger from extinction have resulted in establishing fourteen special reserves (Mountfort, 1974). Of these, nine selected areas belong to India, to save the race of the Indian Tiger, of which we have with us about a couple of hundred remaining individuals.

Though the Dangs Forest in Gujarat State does not boast of a fairly large population of the tiger, in the eyes of the author, its environmental conditions and the floristic elements have a close parallel with those of the Melghat in the Maharashtra State. Unfortunately, this habitat has not been taken into consideration as one of the reserves to maintain viable breeding populations of the endangered tiger. This is

therefore to plead that Dangs Forest can still be an addition to our eleven magnificent reserves, viz., Manas (Assam), Palamau (Bihar), Simplipal (Orissa), Corbett (Uttar Pradesh), Melghat (Maharashtra), Bandipur (Mysore) and Sunderbans (West Bengal), Periyar (Kerala) and Sariska (Rajasthan), Kanha (Madhya Pradesh) and Ranthambhor (Rajasthan).

In India, natural habitats like the Dangs Forest grow fewer year after year! This is a national issue, and unless we seriously endeavour to save such habitats from manifold destructive activities of Man, as early as we can, the rich heritage of natural resources and the modest wildlife – incidentally the natural prey of the tiger, will be lost permanently and we shall be deprived of our prized possession. There is an urgent need to maintain ecological balance in the Dangs Forest.

In recent years, the condition of the Dangs Forest has deteriorated to a great extent. The land in the forest proper was given to local people, at nominal rates, for cultivation. This has left behind disastrous effects for the forest; as erosion has started already the fertility of the soil has disappeared. Thus we have failed miserably in the forest management, nor have we succeeded in getting good harvest from cultivated lands. On top of this, in drought conditions we have permitted the migration of thousands of cattle for grazing in and around the Dangs Forest. In the recent past tigers lived in the Danta Forests (Palanpur district of Gujarat State) happily, but the poachers slaughtered them mercilessly. It is known to one and all the precarious conditions

Dangs Forest is the last abode of the Indian Tiger in Gujarat. To save this magnificant animal for posterity, Gujarat can still boast of a fine reserve in this area and an environment with the characteristic floristic elements which need conservation.

The author is Founding Editor of the Quarterly Journal – **Environmental Awareness,** *devoted to the cause of environmental conservation for human welfare. His address is: Dr. G.M. Oza, M.Sc., Ph.D., F.L.S., Founding Editor: Environmental Awareness, (Indian Society of Naturalists INSONA, "Oza Building", Salatwada, Baroda 390001, India.*

Reference

Mountfort, Guy 1974. **International Efforts to save the Tiger from Extinction.** Biol. Conserv. 6: 48–52, f. I, map I.

(Photo: Y.R. Ghorpade)

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INTERNATIONAL SYMPOSIUM ON BUSTARDS

1, 2, 3 NOVEMBER 1980 JAIPUR (INDIA)

Background Paper

Bustards (Family *Otididae*) are magnificent, cursorial birds, inhabiting open country. Once upon a time they were abundant. But those good old days are gone. Their numbers have dwindled. They are still declining in as much as that Bustards have disappeared from certain geographic areas in several countries. The expansion of modern agriculture, parcelling of land for ever-increasing human population, omnipresent and swelling numbers of grazing livestock have destroyed the Bustard habitats. Persecution by man and low recruitment rate of Bustard – they attain maturity at the age of 4-5 years, and lay only one egg annually – are the other reasons for the decimation of their numbers. Though the Bustards are fast vanishing from the earth, surprisingly, not much attention has been, and is being, paid to augment conditions conducive to Bustard-survival.

Bustards are large gallinaceous birds. Their size ranges from that of a domestic cock to larger than a peafowl. They have long legs and their feet are sturdy with three short, strong toes. They live partly in pairs, and partly without a definite pari bond. The courting behaviour is an effective display of the plumage. They feed on grasses, herbs, plant parts, as well as on insects, especially grasshoppers and bugs; and also mice, lizards, snails and other small animals. They are difficult to be kept under human care. Their breeding in capitivity is reported in one country only.

The case of Great Indian Bustard is similar, having declined in number over the past decades. It is reported in certain isolated pockets in the arid and semi-arid regions of Rajasthan and Gujarat in India. Different State authorities in India are believed to be attempting a broad census of this bird. The forest and wildlife authorities in the State of Rajasthan have undertaken an ambitious task of establishing a Desert National Park. The Park is expected to provide a protective cover to a number of species, prominently the Great Indian Bustard.

Bustards have already been included in the list of the endangered species. Their loss has aroused a considerable alarm all over the world. Such birds are of tremendous benefit to society in maintaining the ecological balance. Their extinction will certainly cause a big dent on the ecological front. The more lamentable fact is that not even adequate information about Bustards is available at one place. The world appears to have undermined their worth over the years.

The International Symposium On Bustards is being organised at Jaipur to provide a forum for taking stock of different aspects related to Bustards. The major objective of this Symposium is to draw attention of the world scientists, wildlife conservationists, administrators, decision-makers, and politicians towards the need for Bustard-conservation. It is expected that the Symposium will throw fresh light on Bustards, and the information and data to be documented in the process will lay guidelines for the whole world to act upon. The Tourism & Wildlife Association of India (TWAI) has already made extensive efforts to build public opinion for their protection in India.

The 3 - day Symposium will be divided among different sessions to discuss :

1. Status of Bustards in different countries.
2. Ecology and behaviour of Bustards.
3. Breeding of Bustards, including in captivity.
4. Strategy for preservation of Bustards.
5. Education on conservation and legal protection.

Participants are requested to send in their papers on any of the above aspects by 1 AUGUST, 1980.

All correspondence may be addressed to: Harsh Vardhan, General Secretary, TWAI, C-158 A, Dayanand Marg, Tilak Nagar, Jaipur, India.

A PELICAN'S PATHETIC PLIGHT

by K.K. Neelakantan

A Pelican Project is an emergent need of the day. Saving the Grey Pelican (Pelecanus philippensis philippensis) could be a conservation target for the 1980's.

Sadly overlooked by those responsible for the listing of rare and endangered species is a bird that was found in millions around the year 1880, swarming over a breeding centre that covered a hundred square miles, a bird, moreover, that may become extinct by 2000 A.D. if not earlier. Surprisingly, it is not one of those tiny nondescript skulkers seldom seen by bird-watchers; nor is it, like the Mauritius Kestrel or the Atitlan Giant Grebe, a bird of very restricted distribution. On the contrary, our subject is a huge bird, hard to overlook. It was once upon a time widely distributed over a vast area which included Burma, Malaysia and Thailand in addition to India, Pakistan and Ceylon. The size of a large goose and with a wingspan of 8 to 9 feet, the bird is equipped with a long, dagger-like bill from which hangs a conspicuous and capacious pouch. It is known as the Grey Pelican and also as the Spottedbilled Pelican *(Pelecanus philippensis philippensis.)*

From millions to mere hundreds in fifty years

Little more than a century ago, in 1877 to be more precise, Eugene W. Oates (one of the founders of Indian ornithology), stood spell-bound on the banks of the Sittang river in Burma, regarding with awed disbelief the spectacle of millions of huge birds busily engaged in the propagation of the species. Penguins, gannets and flamingoes may congregate in countless numbers at their breeding places, but in a forest habitat such assemblages are extremely rare. In fact the Sittang Valley pelicanry was unique.

Sixty years later B.E. Smythies wrote, "Since Oates's day much of the area has been cleared of its timber and though the colony is still said to exist in the remnants of the forest along the right bank of the Sittang, no one appears to have visited it . . . in recent years." (The Birds of Burma, 1940.) Only fourteen years later J.K. Stanford stated, "The southern end of this forest has all disappeared with cultivation and so have most of the pelicans. In ten years in Lower Burma I set eyes on only one solitary bird." (A Bewilderment of Birds, 1954.) Regarding the bird's position in Pakistan, Guy Mountfort observed that White and Spottedbilled Pelicans were once numerous over the rivers and jheels of Pakistan and that by 1969 they had been "almost exterminated, on the grounds that they ate too many fish. Plans for a factory on the Indus River to extract oil from their carcasses had to be abandoned when it became clear that there were none left to kill." (The Vanishing Jungle, 1969.) With regard to Thailand, Dr. Boonsong Lekagul remarked in reply to my enquiry", I have not personally seen one for some time now. . . No one I have asked has ever known of the pelican nesting in Thailand. . More recently even sightings have become rare." (pers. comm., January, 1979.)

The Tragedy of Kolamuru

The question Stanford asked in 1954, "But where have the millions of pelicans vanished?" has never been answered. Perhaps the answer is only too obvious. We may safely assume that between 1880 and long before 1954 most of those birds had perished.Whether, in addition to loss of habitat, some pestilence too took its toll we have no means of knowing. On the basis of the meagre knowledge available we may hazard a guess that almost all the Grey Pelicans left alive are now restricted to India and Ceylon. So far as India is concerned, between 1940 and 1980 nesting by the Grey Pelican appears to have been recorded only in the following places;–

1. The Kaziranga Wildlife Sanctuary, Assam
2. Sajne Kahl in the Sunderbans, W. Bengal
3. Kolamuru and neighbouring villages, W.Godavari Dt., Andhra Pradesh
4. Sulurpetta, southern Andhra Pradesh
5. Bellur and Bannalli villages, Mandya Dt., Karnataka
6. Kanjiramkulam village, Ramnad Dt., Tamil Nadu

& 7. Kundakulam village, Tirunelveli Dt., Tamil Nadu.

At rare intervals a few pairs have nested elsewhere, as in the Vendanthangal bird sanctuary in Chengalpattu Dt., Tamil Nadu, and Moondaidappu, not far from Kundakulam (No. 7 above.) Of all these, however, the only important breeding centre was the one at Kolamuru where, in 1960, E.P. Gee counted 1500 nests. The well-known wildlife photographer, M. Krishnan, was probably the last naturalist to see pelicans breeding at Kolamuru. That was in January 1968. He found only 400 pairs nesting that year. In December 1974 S.N. Guttikar searched the whole

Grey pelican (Photo: E.P. Gee, Courtesy of the Bombay Natural History Society, India)

area and failed to see even a single bird.

Meanwhile, in 1958, thanks to Dr. Salim Ali, the Indian Board for Wildlife decided that the Kolamuru pelicanry should be given protection and made a gazetted bird sanctuary. Consequently a survey was conducted and a detailed report submitted to the Government of Andhra Pradesh. The report stressed the fact that owing to the nature of this pelicanry it called for no elaborate organisation or large financial outlay to protect it. While it is impossible to say what had caused the pelicans to desert this nesting place, it is clear that few alternative breeding places are available to the birds unless it be in the Sunderban of W. Bengal.

Desperate Remedies

Is the Grey Pelican, then, doomed to die out shortly? What are the factors for and against its survival? Can anything be done now to save the species? These are large and difficult questions. Only some vague and sketchy answers are offered below.

The Grey Pelican is still seen in small numbers in the salt marshes of Point Calimere (Kodikkarai, Tanjore Dt., Tamil Nadu), Lake Pulicat on the border between Tamil Nadu and Andhra Pradesh, and in still smaller numbers on the surviving irrigation tanks scattered about all over the eastern side of the Indian Peninsula. In the absence of reliable figures the total strength of this vagrant population can only be guessed. Even if we put the figure at about 2000 pairs it is only a very small percentage of the numbers seen by Oates in 1877. Now that the Kolamuru pelicanry has been wiped out, a question of paramount importance is, how many of these survivors manage to nest successfully, and where? The presence of a floation population of 3 to 4 thousand Grey Pelicans should not be taken to mean that the species is holding its own against all odds. Pelicans have a life-span of 50-60 years.Therefore, a good proportion of the birds seen today may well be aged individuals that have

never bred and are unable to breed for want of suitable nesting places.

It is not nesting sites alone that are scarce. The Grey Pelican appears to need large expanses of comparatively shallow water to feed in. Suitable *jheels* (irrigation tanks and shallow lakes), once numerous, have either disappeared or are subject to continuous human disturbance so that the pelican can no longer resort to them. The extensive Kolleru Lake close to the now defunct Kolamuru pelicanry has been subjected to various kinds of development. On one side fish breeding and fishing have been organised on a large scale by the Kolleru Lake Fisheries Co-operative Society. According to a 1972 report the Society was exporting 20,000 tonnes of fish annually to Calcutta alone. But, simultaneously, there have been other developments too. Sugar factories on the banks of the canals flowing into the Kolleru release their effluents into the canals; waste water, boiling hot, from numerous rice mills also finds its way into the lake. Sewage and strong solutions of fertilizers and insecticides from the paddy fields poison the water. All this results in heavy fish mortality in the lake, particularly between December and July. This affects not only the fisheries, but also birds like the pelican that need large supplies of fish for their own sustenance and the rearing of their young ones..

One of the reasons suggested by S.N. Guttikar (1979, Journal of the Bombay Natural History Society, Vol. 75, pp. 482-84) for the disappearance of the Kolleru pelicans is that around 1964 pelicans of this area died in large numbers. Whether this was due to some pestilence or to the very liberal use of pesticides in the surrounding fields and orchards is a moot-point. If it was pestilence, there is every chance of the birds thriving again if they could be persuaded to return to their traditional breeding place. If it was due to the indiscriminate use of pesticides, such use could be banned or controlled. Either way, the reintroduction of the pelican to the Kolleru area need not be ruled out.

The conversion of the Kolleru Lake into canals and pools or even paddy fields need not be a serious deterrent. I believe that the pelicans used to obtain most of their food from the flooded fields (known locally as 'blanks'), the large canals, and from the backwaters on the Krishna coast (e.g. the Guyyeru Creek), and not from the Kolleru lake.

Enough has been said to show that the Grey Pelican is in a sad predicament. Let us see whether the disappearance of the pelican is likely to help or hurt the fishermen and the farmers of the region. The pelican is not a voracious bird. Although it may weigh 15-16 lbs., an adult pelican requires only 2 lbs. of fish (2 kg according to some authorities) per day. During the breeding season the food requirements will naturally be considerably higher. Still, the fishermen of the Kolleru never regarded the pelican as a serious pest. The farmers recognised the bird as a benefactor for they were well aware of the value of the pelican's droppings as a natural fertiliser.

What are the prospects of preserving this species? Although there has been a catastrophic reduction in the population of the Grey Pelican, it may still not be too late to save the species. Assuming that there are some 3 to 4 thousand Grey Pelicans still alive and capable of reproduction, they will require only 2 to 3 square miles of land with suitable nesting trees such as palmyra, rain tree, banyan, neem, tamarind etc. One large tree can accommodate as many as thirty to forty nests. An area ten times as large could be acquired in the Kolamuru region and carefully developed by planting a large number of suitable trees including the thorny acacia whose twigs provide ideal foundations for the pelicans' nests. This need not interfere with normal agricultural activities provided that the farmer will leave the birds alone. Young birds of a suitable age collected from some of the smaller pelicanries should be taken to this place and reared there. Such an experiment was conducted very succesfully at the Delhi Zoo a few decades ago when the 'Indian Marsh' was established there. A similar experiment to establish the Grey Pelican as a breeding bird should be tried in the Sunderbans where there is already a small colony. Although the Keoldeo Ghana of Bharatpur does not appear to have attracted the pelican (perhaps because the pelican, though it likes to associate with such birds as the Adjutant Stork, does not seem to thrive in a heronry where many different species of waterbirds compete for nesting sites), if the Ghana is saved from the threats it now faces, the Grey Pelican could be introduced there too as its protection will involve no additional expenditure.

It is only by developing 3 or 4 large breeding centres that we can avert the danger of the bird's extinction through epidemic diseases and other calamities. An isolated population, however large and well protected, may meet with the same fate as the Sittang pelicans.

Meanwhile the Grey Pelican should be included in Schedule I of the Indian Wildlife Act. All the breeding and feeding places and other resorts of the bird should be identified, and at places of major importance guards should be appointed to prevent the persecution of the birds. The people of all these places should be made aware of the need for such action as well of the benefits the pelicans will bring them.

All these are tentative and random suggestions only. To do anything worthwhile we need more information. An urgent campaign should be started, calling for information from naturalists all over India, Ceylon and Southeast Asia on the breeding and feeding places of the Grey Pelican. A small party of scientists should systematically cover Andhra Pradesh, Karnataka and Tamil Nadu, Bangladesh and West Bengal, in order to discover the present and past haunts of the pelican. This has to be done as expeditiously as possible. World Wildlife Fund and similar organizations should recognise the plight of this species and come forward with funds for exploratory and preservational programmes.

The plight of the Grey Pelican is, if anything, more desperate than that of the tiger. It takes very little courage or effort to shoot a pelican! There is every justification for starting a Project Pelican in India and for concentrating in the coming decade on the problems of preserving this harmless, fascinating, highly beneficial, but fast disappearing water bird.

Recognising the Grey Pelican

The Grey (Spottedbilled) Pelican (*Pelecanus p. philippensis* Gmelin) is *the only pelican without any black on its underside including the wings.* Seen from below, its wings are a uniform dull white. It has lead-grey or brownish legs and feet. The pouch is purplish with numerous spots and splotches of a darker hue. *On top of its one-foot long, flattened bill are two parallel rows of bluish-black spots running from end to end.* Where the feathers of the forehead meet the bill, the line of demarcation has the shape of the letter W (whereas that of the White or Rosy Pelican forms a V.) The flight feathers of the White Pelican when seen from below are jet black; its legs and feet will be pink or red. The Dalmatian Pelican's underwings and legs resemble those of the Grey Pelican, *but its yellow bill is unspotted.* It is, moreover, a whiter looking bird than the Grey Pelican.

Prof. Neelakantan is President, Kerala Natural History Society.

WORLD WILDLIFE FUND PROJECT NO. 1328 HIMALAYAN MUSK DEER, INDIA

by Ajit Narain Singh

The Musk deer *(Moschus m. moschiferous L.)* occurs in the Garhwal Himalaya at an altitude of approximately 2600 to 3600 metres in montane, subalpine forest and alpine scrub. The body is covered with a thick coat of wavy and structurally distinctive hair which effectively insulates the deer from extreme cold. This deer has several other unusual features, of which some are worthy of note. They include the well-developed upper canines which project below the lower jaw and the elongated hind limbs. Owing to this unequality of the limbs, the back of the animal is arched, somewhat like a bow. All the four toes have considerable flexibility which ensures a firm purchase when the deer is negotiating precipitous cliffs. In snowy conditions, the toes become splayed, by the body weight, thereby preventing the animal from sinking deep into the snow.

By habit, the musk deer is a shy animal, coming out to feed only at dawn, dusk and overnight. During the daytime it remains hidden in dense shrub. The diet mainly consists of leaves of *Quercus incana, Rhododendron campanulatum* and *Skimmia laureola* as well as herbs and grasses. In winter when such food becomes scarce, musk deer may have to rely exclusively on mosses and lichens. The incisors are modified, spatula-like, and well suited for chiselling out mosses and lichens from rocks and the bark of trees.

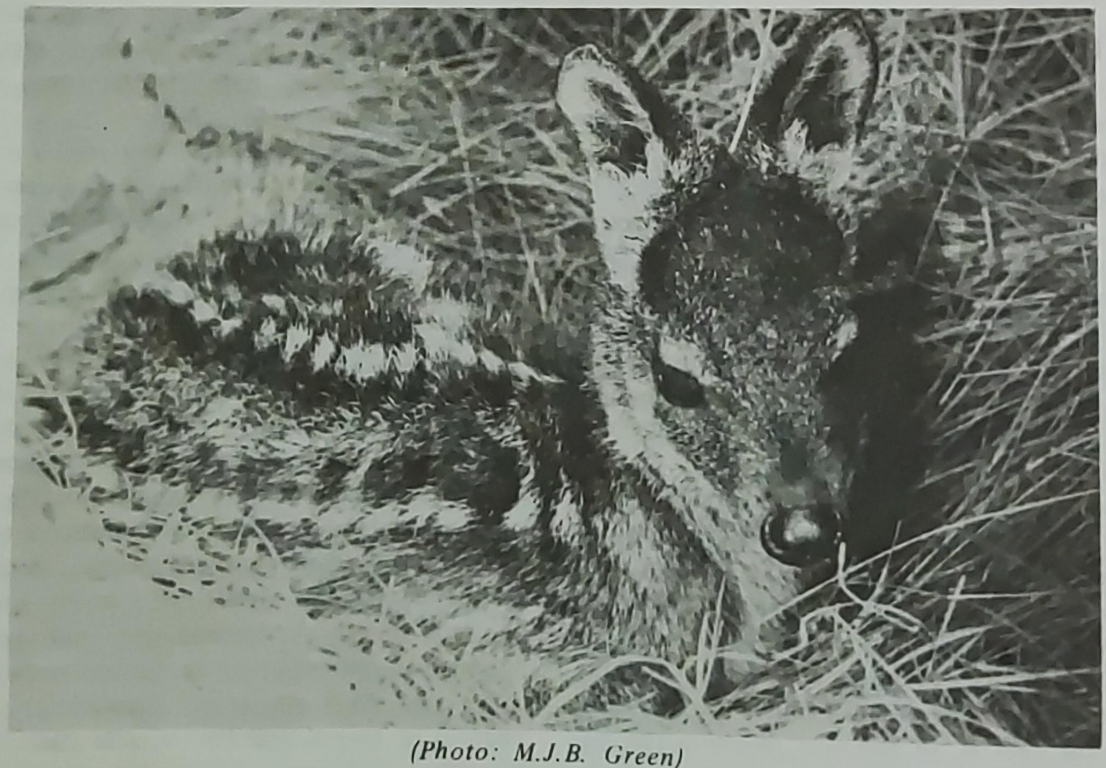
Sadly, this unique species of primitive deer faces extinction owing to intensive hunting for its musk. This valuable possession of the male animal only, occurs in an abdominal pouch located between the navel and genitalia. Despite males being the sole possessors of musk, in the lust for this commodity females and jueveniles are also indiscriminately killed. Such wholesale slaughter is causing the fast decimation of populations.

The death knell of the musk deer is the exorbitant price which musk fetches on the black market. At the turn of this century musk fetched about Rs. 10 per tola (11.6 g), the price then being equivalent to half its weight in gold. Today, musk costs Rs. 3000 per tola and is worth three times its weight in gold. In India and other Southeast Asian countries musk is used in Oriental medicine; in Western countries it is used in perfumery because of its fixative qualities. Consequently the species is now listed as "vulnerable" in IUCN's **Red Data Book.**

In 1979 the World Wildlife Fund initiated Project No. 1328 in the Garhwal Himalaya, India, to study the ecology and behaviour of the musk deer with a view to ascertaining the conservation requirements for the species. The project is based near Tungnath temple in the Kedarnath Forest Division of Uttar Pradesh. Here Mr. M.J.B. Green of Cambridge University, U.K. who had previously studied Himalayan tahr in the Langtang National Park, Nepal, and myself, from Lucknow University, U.P., are based at Shokh (3000 m). A tubular hut has been constructed by the Wildlife Preservation Organisation of U.P. and serves as our base.

Realising the importance of this project, the WWF has extended it for a second year. Part of the work will include radiotracking musk deer to study its behaviour in the wild. In order to disseminate knowledge about radiotelemetry, I was deputed by Mr. V.B. Singh, Chief Wildlife Warden, W.L.P.O. to attend the IInd Course in Radiotelemetry and Immobilization conducted by Project Tiger, India. This was held at Delhi Zoo, Corbett National Park, U.P., and Kanha National Park, Madhya Pradesh, under the expertise of Prof. U.S. Seal and Dr. L.D. Mech from Minnesota University, St. Paul, U.S.A.

The research and related activities of this project have received constant incentive and guidance from Mr. V.B. Singh. According to him the W.L.P.O. proposes to establish a musk deer breeding farm at Shokh for which the necessary funds have already been sanctioned. The first priority will be to rehabilitate animals in the wild; subsequently it should be possible to extract musk from live animals for commercial purposes. To extract musk, surgery is not neccessary. In China, musk is extracted from live animals by inserting a silver spatula in the external orifice of the musk pod and gently scooping out the musk. Care should be taken not to insert the spatula into the orifice of musk pod to a depth of more than 2.5 cm. According to the Chinese the animal tolerates the operation quite well and leads a normal life thereafter.



(Photo: M.J.B. Green)

WORLD'S MOST ENDANGERED MAMMAL – MANIPUR BROW–ANTLERED DEER *(Cervus eldi eldi)*

by Ashbindu Singh

The geographical distribution of the Brow antlered deer extends from Manipur (Northeastern state of India) to Burma, Thailand, Kampuchea through Laos and Vietnam. There are three races confined to characteristic ranges i.e. the Manipur brow-antlered deer *(Cervus eldi eldi)* in Keibul Lamjao Wildlife National Park of Manipur; the Burmese race *(Cervus eldi thamin)* in Burma and Thailand, and the Thailand brow-antlered deer *(Cervus eldi siamensis)* in Thailand. The Manipur race, locally called Sangai, has dwindled considerably since the beginning of the twentieth century. In fact, at one stage Sangai was believed to be extinct in the wild but a small herd was discovered in Keibul Lamjao in 1950.

The Sangai is nearly 120 cm high at the withers. The hinds are smaller. The maximum length of the antler is 107 cm. The coat of the animal is coarse and sparse. In the stag it is a dark brown or nearly black. Hinds are a light fawn color. The young are spotted. There appears to be a seasonal colour change, the dark brown thamin of the cold season developing into the yellowish brown animals of the hot weather. Stags shed their antlers in mid-August. The fawns, usually one, are generally born in October. The period of gestation is 239 to 256 days (Quoted from The Book of Indian Animals by S.H. Prater, 1971).

Keibul Lamjao National Park

Keibul Lamjao, perhaps the only floating park in Asia,is situated about 50 km south of Imphal, the capital city of Manipur State. It forms a part of Loktak Lake, which is the largest lake of the region. The altitude ranges from 850 meters to 950 meters. It was an unclassed forest till 1974 when it was declared as a Reserved Forest under section 20 of Indian Forest Act, 1929. In 1975 an aerial survey revealed that the last 14 head of Sangai were waiting for their final extinction. So the State Government in 1977 declared 40 sq. km. of the area as a National Park under the Wildlife (Protection) Act 1972.

The National Park is unique in its configuration. It covers a vast stretch of low lying swamp with floating swamps, locally called phumdi, covering a third of the whole area. The National Park is divided into two halves, eastern and western, by a perennial stream. The boundary of the National Park and Loktak lake is demarcated by a small hill range stretching between the two in an east-west direction.The National Park is surrounded by eleven villages and the boundary of the Park is in the proximity of the paddy fields of these villages, except on the Northern side where the Park touches Loktak Lake.

Habitat

Sangai occupies a peculiar habitat within Keibul Lamjao National Park, i.e. tall reeds, grasses and other plants growing on a mat of dead or decaying vegetation. This mat actually floats on the lake with one-fifth of it above the surface of the water and four-fifths of it below. Phumdi is a mat of organic matter in which tall reeds and grasses grow up to 15' or more. It is subdivided into *Phumdi ataoba* (floating) and *Phumdi aruppa* (sinking). Phumdi varies in thickness from 6" to about 5' and is capable of supporting the weight of animals thriving there. In places where *Phumdi ataoba* is absent a tall reed grows on the bed of the lake in sinking phumdi and it covers approximately 5% of the area of the National Park. It is eaten by Sangai and other domestic cattle. The main reeds and grasses growing on phumdi are identified as : *Phragmites karka* – 45%, *Erianthus ravennae* – 25%, *Saccharum bengalense* – 15%, *Zizania latifolia* – 5%, *Alpinia allughas* – 5%, *Saccharum procerum* – 2%, and Miscellaneous – 3%.

Although a detailed study of rare and semi-rare species in this area has not yet been made, *Zygenia latifolia* can be regarded as a rare species. This species is much sought after by local people who collect the fungus impregnated vegetative portion which is edible and rich in protein content.

The Sangai have shared this unique ecosystem with other animals and birds such as Hog deer, common otter, Large Indian civet, Small Indian civet, Indian wild boar, etc., for ages.

Animal Population

Every year since 1975 a regular animal census has been carried out from the air using an Air Force helicopter. The use of a helicopter for the annual aerial census has become imperative because of the semi-floating habitat of the animal formed by a tangled mass of reeds and grasses with humus on top which the various vegetative growth peculiar to the region has developed. The aerial census is not very easy as the rank growth of reeds and other tall grasses hides the animal. However, during the last week of March every year when grasses are comparatively low, the chances of animal visibility is quite high. The result of various aerial surveys conducted so far are:

(Photo: A. Singh)

Year	*Number of Animals*
First Census March 1975	14
Second Census last week of February 1977	18 (6 stags, 8 hinds, 4 fawns)
Third census 4th March 1978	23 (9 stags, 10 hinds, 4 fawns)
Fourth census 4th March 1979	30 (9 stags, 13 hinds, 8 fawns)

Besides the 30 head in the wild, quite a few Zoological parks of the country have Sangai in captivity. Since the Sangai is obviously on the threshold of extinction it has appropriately been declared as a protected animal and included in Schedule – I of the list of animals of the Wildlife (Protection) Act, 1972.

Protection Problems

The National Park is at present being heavily encroached upon by villagers for cultivation, fishing, collection of reed for firewood, and edible roots, grazing of domestic cattle. There was a violent demonstration in February 1979 against the enforcement measures in the park. A mob of 600 people incited by vested interests forced entry into the park and opposition by the subordinate staff of the forest department caused them to rage rampant. They set fire to dry grasses, check posts, staff quarters, the animal observation tower, etc. Also organised marches were carried out in Imphal and a list of demands was presented to the concerned authorities. The District administration has enforced prohibitary orders over the National Park area. The main demand of the people is to reduce the area of the park from 40 sq. km. to about 15 sq. km. A local committee comprised of politicians, officials and villagers has been set up by the State Government to examine the issues *de novo* and suggest appropriate measures.

Conclusion

Sangai is in dire need of preservation since it is the most endangered mammal of the world. In the prevailing politico-socio economic environment it is difficult to visualise how rigorous enforcement measures can save this small patch of Keibul Lamjao from the onslaught of people in the densely populated Imphal valley. Therefore a publicity campaign should be launched to convince the people that they are on the threshold of losing this unique nature's pride of Manipur. Scientifically, a two-pronged attempt is urgently needed (1) Habitat analysis of Keibul Lamjao to understand the eco-system dynamics of the Sangai (2) captive breeding of Sangai in various Zoological Parks in the country. These will help in reviving the population above the critical level for the sake of posterity.

The author is with the Indian Forest Service, Central Forest Division, Imphal.

NEW WORLDWIDE PLANS TO SAVE TURTLES

The World Conference on Sea Turtle Conservation (Washington DC, 26-30 November) was remarkably successful. Over 300 participants registered and more than 40 papers were given.

The Conference was hosted by the US State Department.

The meeting brought together for the first time a large number of people concerned with this issue who had no idea that there were so many others equally concerned. It also immediately triggered some conservation action. For it enabled representatives of Sabah and the Philippines to get together and reach preliminary agreement on an international turtle sanctuary.

A major effort – to which IUCN's Dan Navid and Bob Scott contributed significantly – resulted in a "sea turtle conservation strategy". This document contains the following sections.

Situation and Objectives: A brief summary of the status of sea turtles and the object of their conservation.

The Problem: A brief statement of the factors adversely affecting sea turtles.

Turtle Conservation Policy: A detailed statement in outline form of the policy considerations for conservation of sea turtles, including preferred and priority actions, organized under the headings of *habitat protection, management, control of exploitation, incidental catch, research and population assessment, conservation education, legislation, cooperative efforts.*

Implementation of the Strategy: A standing committee is established to monitor and facilitate the further development and the implementation of the strategy. The Committee is, in effect, the IUCN turtle group expanded to include adequate regional representation. It is to meet with the IUCN Survival Service Commission at its meeting immediately prior to the third conference of the parties to CITES, in early 1981, to prepare and present a progress report. IUCN and WWF "are requested to accept responsibility for the overall coordination of this standing committee" and "the active cooperation of the various elements of IUCN. . . is essential".

Action Plan: This is a 9-page matrix identifying the needs, actions necessary to deal with them, and examples of specific projects to accomplish the action.

Action Projects: These are largely one-line descriptions of 93 action projects identified in the action plan.

THAILAND'S TURTLE ISLAND

At the request of the Queen of Thailand, the Thai Department of Fisheries is now participating in a new project for breeding and releasing green turtles in the Gulf of Thailand. Her Majesty has donated an island, Mun Nai, for this purpose. Turtles used to nest here before they were exterminated by hunting.

from **IUCN Bulletin** *Dec. 1979*

CHINESE ALLIGATOR

The International Herald Tribune of July 22 refers to a report by the Chinese news agency about the conservation of the Chinese alligator, *Alligator sinensis.* The original New China News Agency report reads: "Measures have been taken to protect China's alligator, a rare reptile on the verge of extinction at its home in the Jiaxing area of Chekiang Province. The measures include the setting up of an organization to look after the reptile and determine how best to protect the breed and ensure its survival. A recent study undertaken by the Institute of Zoology of the Chinese Academy of Sciences showed that the number of Chinese alligators has declined considerably and that the reptile is to be found in fewer and fewer places.

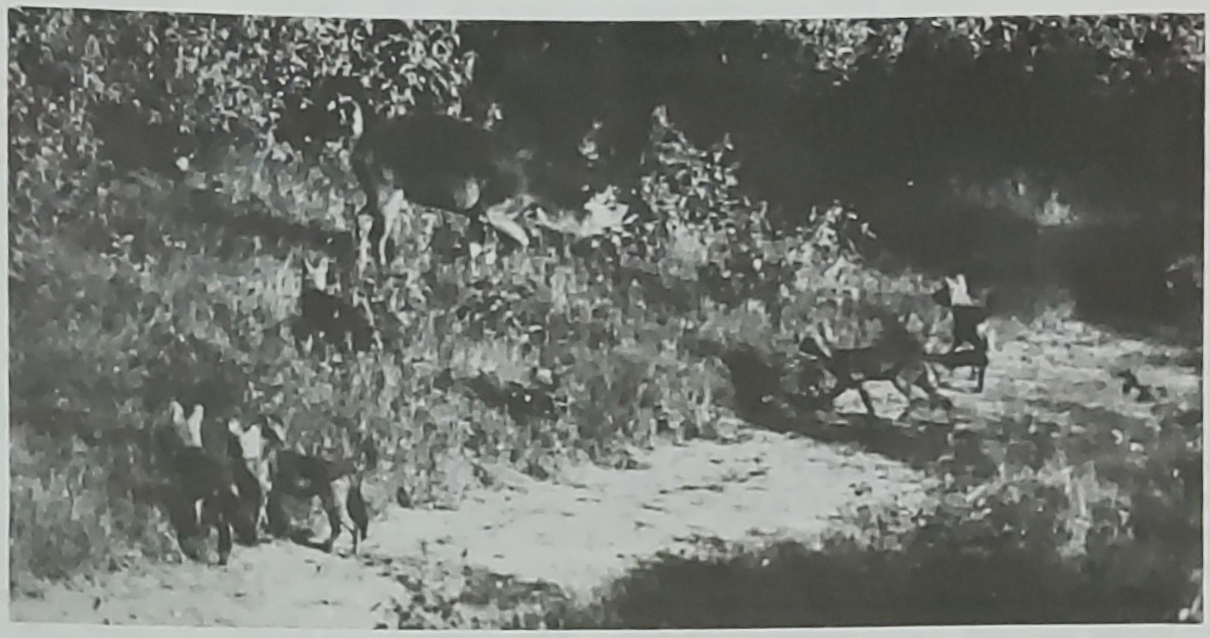
"The reptile has survived for more than 200 million years. It used to frequent the reed marshes along the middle and lower reaches of the Changjiang (Yangtze) River but with changes in geological and other natural conditions, it went to stay in the bamboo groves on the beaches of the Xizhoaxi river in the Jiaxing area of northwest Zhejiang (Chekiang).

"Since the founding of New China, it has been used as a gift for foreign (dignitaries) or as a favourite for international animal exchanges, and the reptile has now been listed as one of those species deserving urgent protection.

"During the present season the alligator comes out to search for food, and this is also the mating season. Local people have been instructed to safeguard the bamboo groves which are part of the creature's natural habitat."

Dr. Huang Chu-chien is working on the biology of the Chinese alligator. His address is c/o Peking Institute of Zoology, Academia Sinica, Peking, China.

from **International Union for the Conservation of Nature Crocodile Specialist Group Newsletter** *No. 16 September 1979*



Sambar–Dhole interaction (Photo: A.J.T. Johnsingh)

Cuttack, December 17 (UNI):

Tiger population has nearly doubled since the inception of "project tiger" in the Simlipal hills six years ago.

But more spectacular increase in the predator population in the sanctuary during the period has been that of wild dogs, which was posing a problem.

According to the Simplipal tiger reserve director, Mr. Sorojraj Choudhury, wild dogs are now found in all opened-out areas in the 2750 sq. km. expanse of the rolling table land in north Orissa.

In a message on the occasion of the inauguration of the Simplipal forest development corporation, Mr. Choudhury says wild dogs, the most destructive competitors with the tigers, are at the moment posing considerable problem in the management of tiger, its habitats and its niche, however, he did not suggest any measure to deal with the menace.....

from **The Times of India,** *18 Dec. 1979*

ARE DHOLES *(CUON ALPINUS)* A REAL THREAT TO TIGERS?

by A.J.T. Johnsingh

Since September 1972 after the launching of the Project Tiger there has been an appreciably growing concern for the tiger – the most magnificent predator nature has evolved so far. The conservation measures taken in many a forest tract of India have begun to assure the conservationists that the tiger may not become extinct in the near future. Paradoxically, there was a time when the tiger was considered a vermin in some parts of India; but, fortunately, the attitude of man has changed and the status of the tiger, among all wild animals, is now enviable and the killing of a normal tiger would lead a man to dire consequences. However it is regretable that even now, a predator like the dhole *(Cuon alpinus)*, which is disappearing fast from many of its habitats, is being despised and maligned by many forest officials and naturalists. In this article, I would like to disentangle the truth from two misconceptions about the dholes, one of the pack hunting canids.

One section of conservationists in India advocates the eradication of the dhole on the ground that dholes kill too many deer. The reason they attribute to the susceptibility of the deer to the dhole is the loss of habitat. According to them, when the forest was vast, the deer migrated from one area to another when pursued by dholes. Based on my recent study of the dhole and its prey species, mostly chital (*Axis* sp.), and sambar (Cervus unicolor), in the Bandipur Tiger Reserve, I should say that this view conveniently ignores two aspects of the behaviour of the deer. One is that the chital and the sambar, which are the most common prey species of the dhole, do not have a long distance migration but have a limited home range to which they are almost chained. Many

a time have I observed that the chital and the sambar, even after they were driven out of their home range by dholes, go back to their home range either on the same day or the day next. Long distance migration may not be possible even by animals like the gaur and the elephant and, in fact, I am not sure of the existence of sufficient data to argue for or against the ability of these two animals to cover vast areas during their annual migration.

The second theory against the dhole is that when a pack moves into an area, all the prey species desert the area which makes it difficult for a stalking predator like a tiger to hunt. My observations, when I photographed the events seen in the picture and many more instances of the reaction of the prey species to dholes, suggest that dholes do not deserve the prejudice.

For example, one morning my study pack was seen hunting in a scrub, a good sambar country, near Bandipur. Anticipating them to come to a view-line in the scrub, I climbed a rose-wood tree near the clearance and waited. That day, the dholes adopted the strategy of sending part of the pack into the scrub to flush out the prey to the rest of the pack. As a result of this, 6 or 7 dholes, the interceptors, were seen on the view line. Soon, a sambar doe came out followed by a yearling doe. Both the sambar bristled the hair on their bodies, keeping the tail vertical, laying flat pinnae and everting the white of the eye. Further, they kept their heads low to the ground, extending the neck as much as possible, snorted and alternately stamped the forefeet and walked through the dholes. After this, out came another doe, and also by this time the dholes, except for one which had entered the scrub, and this dhole while trotting did not even look in the direction of the doe. The part of the pack which had entered the scrub flushed out a sambar doe and then killed and ate a sambar fawn. After the kill was eaten, 3 dholes were seen resting under a treeshade 150 metres away from my tree. At this time 2 adult does and 2 yearling does came out of the scrub, bunched and went close to the dholes and unbelievably the adult does chased the dholes here and there. It appeared to me that the dholes, tails arched, enjoyed being chased.

A number of observations like this and the inclination of the chased deer to return to their home range within a short period of time made me conclude that the presence of the dholes in an area need not necessarily nullify the hunting success of the tiger. If the presence of the dholes is so detrimental to the tigers, it would not be possible for the tigers of the Reserves, such as Similipal, Bandipur and Melghat, where dholes are also common, to register significant increases in numbers after the genesis of Project Tiger.

The dhole is an interesting co-predator of the tiger and an integral part of many of the tiger habitats. If we continue our efforts to control poaching, encroachment, prevent poisoning of kills, remove snares set by the local people, prevent stealing of kills and control forest fires in summer, the tiger, even with the existence of the other co-predators, is sure to be safe with us for many decades.

The author is Asst. Professor of Zoology at Ayya Nadar Janaki Ammal College, Sivakasi, India. He undertook a two-year study of the ecology and behaviour of the dhole (or Indian wild dog) in the Bandipur Tiger Reserve. The field study was supported by World Wildlife Fund – India and International.

Sambar stag (Photo: A.J.T. Johnsingh)

KALIHI ROCK WALLABY OF HAWAII

by James D. Lazell, Jr.

In small caves, ledges, and rugged talus along the sheer cliffs on the north face of the ridge above Kalihi Valley, on the island of Oahu, dwells a population of wallabies. Not, of course, native to the Hawaiian Islands, these wallabies are all believed to be descendents of a single pair that escaped from a private zoo in 1916. The animals had been shipped from Sydney, but no one knows where they were captured. There is a specimen in the United States National Museum and four in the Bishop Museum in Honolulu. The Kalihi walabies certainly belong to the genus *Petrogale* – – rock wallabies – – aptly named for their wonderful agility among the rock precipices of their chosen habitat in both Australia and Hawaii. Dr. G. M. Maynes, of the University of New South Wales, and Dr. G. B.Sharman,of Macquarie University, are studying the group, using not only standard morphological characters but also chromosomes and protein electrophoresis.

The brush-tailed rock wallaby, *Petrogale p. penicillatus,* is today a rare animal occurring in scattered, small colonies from Victoria, through New South Wales, to southern Queensland. It differs in coloration and karyotype from other forms, and has been assumed to be the Kalihi's parent stock. Dr. Maynes noted, however, that the Kalihi animals he examined (skulls only) had smaller palatal vacuities and more robust palatal struts. From the third to the sixth of November, 1979, I studied Kalihi wallabies alive in the field and preserved in the Bishop Museum. Four days later I was at the Jenolan Caves, in the Blue Mountains west of Sydney, looking at living rock wallabies there. The Jenolan population is managed and the area is probably the best stronghold of the species in its native range.

I was struck by the differences. The Kalihi animals are overall greyer with warm brown largely confined to the rump (instead of the whole dorsum, as at Jenolan). The buff belly stands in strong contrast to the dorsal color of the Kalihi, but blends in well on the Jenolan. The dark shoulder is set off posteriorly by light-tipped fur in both populations, but this is just a short axillary bar at Jenolan; in the Kalihi population the white-tipped hairs extend up around the dark shoulder patch and coalesce to form an ashy nape streak middorsally. Perhaps most strikingly, the Kalihis have rich, rusty reddish hairs in the terminal tail brush; the Jenolan tail brush is undistinguished dark brown, nearly black.

What can account for these differences? A "founder effect" is immediately suspect. Stemming from so few (two) individuals, the Kalihi population might uniformly show characters today that occur very rarely in home-grown *penicillatus.* Or, it is possible that the Kalihi stock came from some other population than nominate *penicillatus.* Either I fail to recognize this population (as have Maynes and Sharman in this scenario), or the population is no longer extant. If the former alternative depended solely on me, it would be quite likely true. Depending as it does on fooling Dr. Maynes and Sharman leads me to discount it. The latter alternative is exciting and possibly quite viable: it is known that many rock wallaby populations have been extirpated in Australia. One is reminded of the famous parma wallaby story involving an introduced New Zealand population (see Ride, 1970).

There is a third possibility which, however remote, requires consideration: a new form of wallaby may have evolved from *penicillatus* stock *in situ* at Kalihi. As long ago – – and soon after introduction – – as 1930 Le Souef remarked differences developing between the rock wallabies introduced at Kawau Island, New Zealand, and their Australian antecedents. I have previously (Lazell, 1972) given detailed consideration to the literature, theory, and facts of extremely rapid evolution in various West Indian forms of mammals and reptiles, including post-Columbian introductions.

The Hawaiian population today lives in a tropical regime and a very equable climate. The populations of nominate *penicillatus* in Australia live in a temperate regime with spectacular seasonality. Kramer (1971) did a detailed study of the Kalihi population in Hawaii. Their habitat is in the guava zone of vegetation at its transition to the Kao zone. The native rosaceous plant *Osteomeles anthyllifolia* (ulei berry) is a staple in their diet, but they eat considerable fruit from exotic species escaped from, and at the edges of, cultivation. We found the slopes dominated by the exotic anacard *Shinus perehinthifolius* (Christmas berry), which we were locally assured the wallabies also eat. The ground cover is a lush growth of fern, *Polypodium phymatodes,* with clumps of the primitive bifurcating *Psilotum moa* – – both native. A few individuals of a native *Eupritchardia* palm are also present in the habitat.

The total population of Kalihi wallabies probably does not exceed 50 individuals; most are concentrated on one area of cliffs above the State's material testing laboratory on the Kalihi highway. For the moment, their rugged habitat protects them, as do local residents. They are legally protected by Hawaiian State Law, Division of Fish and Game, Regulation 4.

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Kalihi rock wallaby. The major differences from Petrogale p. penicillatus of New South Wales are: light border of the dark shoulder patch; greyer dorsal color (except on rump); and rusty hairs in the tail brush. An adult female measures about one meter, total length.

IS IT THE LAST KOUPREY?

Cambodia's former ruler, Prince Norodom Sihanouk, in an interview in Peking recently, revealed the continued existence of Cambodia's national animal, the kouprey (a species of cattle), feared by many conservationists to be extinct.

Sihanouk's kouprey, a young healthy male, lived in the garden of his residence when he was under house arrest in Cambodia, and is the second kouprey ever known to live in captivity. The first, also a male, was shipped with other South-East Asian specimens from Saigon to Paris in the mid-1930's.

Discovered for the Western Science in 1937, the kouprey was the last major mammal to enter the biology books. It was declared as Cambodia's national animal in 1964, when only 300 still existed. Dr. Lee Talbot, WWF's Director of Conservation, assisted the Prince in drafting the proclamation.

Bull koupreys are distinctive, up to six feet at the shoulder, with a long dewlap-which perhaps helps control body temperature, like the ears of an elephant-and horns that are the longest and widest of all living wild cattle except the buffalo. In mature males, the horns become split at the ends and as the horns grow longer the split pieces also continue to grow. Female koupreys have lyre-shaped horns, and a grace in movement more reminiscent of deer than cattle, according to the few people who have ever observed them.

The kouprey was considered to be a potential source of food in protein-poor lands where other cattle cannot survive. It is also thought by some scientists to be resistant to the killer-disease of domestic cattle, rinderpest. Hunting and destruction of habitat has driven the kouprey out of Thailand, where it was last reliably sighted in 1948. Kouprey may still exist in pockets of one or two small herds in little-explored areas of Laos and Vietnam, but the bulk of the population has always been centred in Cambodia where the fate of the species is unknown.

from **World Wildlife – India** *3rd Quarter 1979 Newsletter No. 30*

PUBLICATIONS

ECOLOGICAL GUIDELINES FOR BALANCED LAND USE, CONSERVATION AND DEVELOPMENT IN HIGH MOUNTAINS

By Ray Dasmann and Duncan Poore. IUCN, 40 pp, 6 black-and-white photographs, 7.50 (plus postage and packing).

Here is a new title in IUCN's series of "ecological guidelines". The authors are those two eminent ex-IUCN stalwarts, Ray Dasmann and Duncan Poore. The aim of the guidelines is to encourage those responsible for the conservation, management and development of (in this case) high mountains to take ecological factors into account.

In just 40 pages the authors deal with a great many aspects of high mountains and the problems caused by human use. Ecologically sound land-use policies – embracing the conservation of soil and water, forest and pasture, and relatively undisturbed ecosystems – are clearly spelt out. Each subject area has an introductory explanation followed by a set of guidelines.

N.B. IUCN members (States, government agencies and NGOs) wishing to receive a copy of the above book should write to the Membership Services Officer, IUCN, CH-1196 Gland, Switzerland. One free copy will be provided on request.

Non-members wishing to obtain a copy should place their orders with either Unipub or Bowker.

from **IUCN Bulletin** *Nov. 1979*

SURVIVAL OR EXTINCTION – THE PRACTICAL ROLE OF BOTANIC GARDENS IN THE CONSERVATION OF RARE AND THREATENED PLANTS

Edited by Hugh Singe and Harry Townsend. The Bentham-Moxon Trust, Royal Botanic Gardens, Kew, 250 pp.

This book comprises the proceedings of a conference held at the Royal Botanic Gardens, Kew. The conference aimed to high-light the crucial role of botanic gardens in plant conservation and in this it was conspicuously successful. Delegates must surely have returned home stimulated by the ideas – and increasingly the realities – of what is being undertaken around the world.

Establishing a new garden with only minimal resources, undertaking a joint programme with botanic gardens and conservation bodies to conserve an entire country's flora, developing ideas for 'evacuating' critically endangered species to rehabilitated ecosystems – in numerous ways the conference pointed the road ahead as well as proving that success is possible.

One principle emerges clearly; conservation in the wild is nearly always the most desirable policy. Indeed the conservation activities of botanic gardens are most successful when directed to that end.

Special mention should be made of the need for more botanic gardens in the tropics and for more support – facilities and finance – for those already in existence. The conference papers add up, *in toto*, to a powerful plea for plant conservation. They will equip those whose role it is to try to extract funds for this purpose from governments and funding agencies with excellent supporting arguments.

from **IUCN Bulletin** *Nov. 1979*

DUCKS, GEESE AND SWANS OF PAKISTAN

By Z.B. Mirza. World Wildlife Fund Pakistan. 88pp. Wholesale price: RS. 8/–.

WWFP has produced a book on Ducks, Geese and Swans of Pakistan. It contains 88 pages with coloured illustrations of all the species of Waterfowl so far recorded in Pakistan. The description of each bird is complete and concise in this beautiful book. Information about migration, behaviour, sex determination and counting is also given briefly. The text is written by Z.B. Mirza.

Previously WWFP had produced a book on Galliformes of Pakistan i.e. Pheasants, Partridges, and Quails etc. Two more books are in press. One is on Wildlife of Pakistan and the other on Falcons, Eagle and Hawks of Pakistan. The author of these books is again Mr. Z.B. Mirza.

from **World Wildlife Fund Pakistan News Bulletin** *January 1979*